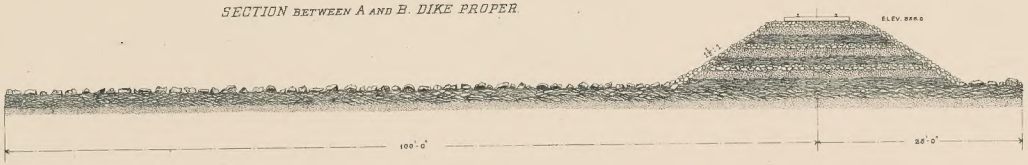
C.B.&Q.R.R.

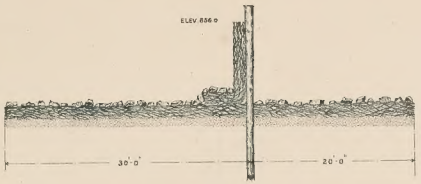
RULO BRIDGE

Details of Dike.

SECTION BETWEEN A AND B. DIKE PROPER.



SECTION BETWEEN B AND C. SCREEN.



Scale.

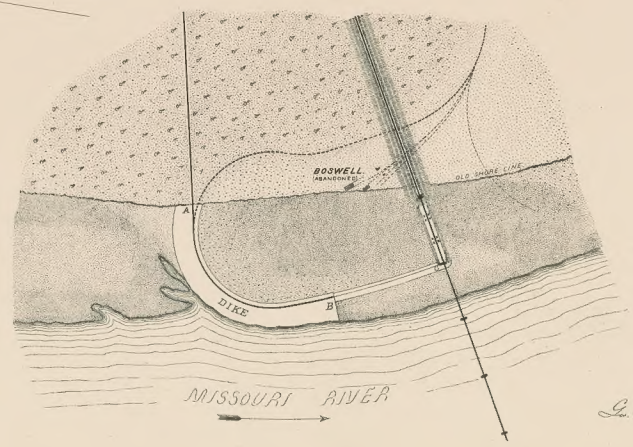
Feet.

Meters.

Scale of Plan.

Feet.

Kilometers.



L. S. Metcalf
C. Engr

Compliments of

GEO. S. MORISON,

Chief Engineer.

The Rookery,
Chicago.

THE RULO BRIDGE.

A REPORT

To CHARLES E. PERKINS, PRESIDENT of the Chicago, Burlington & Quincy Railroad,

BY

GEORGE S. MORISON, Chief Engineer of the Rulo Bridge.

SUBJECTS.

APPENDICES.

PLATES.

1890.

CHICAGO, MAY 1, 1890.

CHARLES E. PERKINS, ESQ.,

President Chicago, Burlington & Quincy Railroad.

Dear Sir:-

I submit the following final report in relation to the construction of the bridge across the Missouri river at Rulo, Nebraska.

Yours truly,

GEO. S. MORISON,

Chief Engineer Rulo Bridge.

THE RULO BRIDGE.

I.

PRELIMINARY NARRATIVE.

Before the completion of the Plattsmouth Bridge in 1880, the importance of a lower crossing of the Missouri to accommodate the Southern lines of your Nebraska system of railroad, became apparent, and I was instructed by you to make an examination with a view to locating such a bridge near the mouth of the Little Nemaha. This examination was made in the season of 1880-'81 and resulted in the selection of a location near the little village of Aspinwall about two miles below the mouth of the Little Nemaha. A bridge built here would have made a direct connection between the railroad leading westerly from Nemaha City to Beatrice and the branch on the east side of the river from Corning to Villisca.

Subsequently the acquisition of the Hannibal & St. Joseph R. R. by your company made a more southerly crossing desirable and the fact that the Atchison & Nebraska R. R. (a portion of your Nebraska System) followed down the valley of the Great Nemaha indicated that a location at Rulo near the mouth of the Great Nemaha would have decided commercial advantages over the Aspinwall location.

The season of 1883-'84 was therefore devoted to examinations and surveys in the neighborhood of the mouth of the Great Nemaha.

The beginning of the work may be fixed as September 13th, 1883, when Mr. B. L. Crosby the Resident Engineer arrived at Rulo. The location at Rulo was fixed by me and borings were actually begun one week after Mr. Crosby's arrival.

These borings showed a state of affairs quite unlike that usually found in the Missouri River, there being no rock within any reasonable depth, but a stiff bed of blue clay, of an average thickness of about 15 feet was found under the alluvial sand, this clay resting on a bed of coarse sand and gravel of varying thickness, which itself rested on a bed of clay, the surface of which was nearly level and which from its stratified character was found to be more truly a shale than a clay. These borings showed that though the bridge when built would be of a satisfactory character, the cost of the foundations would be exceptionally large. It was evidently expedient to examine other points in the same neighborhood.

Borings were accordingly made in the spring and summer of 1884 at White Cloud 10 miles below Rulo and at Arago 10 miles above Rulo, these being the nearest points at which the general topography of the country indicated that the construction of a bridge would be feasible. The borings at White Cloud gave better results than at Rulo, as rock bottom was reached, but at Arago, on the east side of the river, hard material was found only at a depth of 123 feet from top of sand bar, this material being a very soft sand stone. The difficulties in approaching a bridge at either of these points were so great that Rulo was selected as decidedly the best location.

The width of the river at ordinary high water stage at Rulo was about 1600 feet, the channel being next to the west shore. This width being greater than the width required to pass the river, it was determined to reduce this width to about 1100 feet by the construction of a dike above the bridge. Construction of this dike was authorized in October 1884, work was begun on the track leading to this dike October 22d; the dike itself was begun on the 4th of December and completed May 7th, 1885, and an extension in the form of a permeable screen made in the following May and June.

Authority for the construction of the bridge was obtained from the general government in 1884 by an Act which became a law June 18th, 1884. This Act is printed in full in Appendix B.

The location of the bridge had been definitely fixed at the time that Rulo was selected in preference to any other place. The character of the bridge was, however, not fixed at this time. It was evident to me from the beginning that the only proper structure was a high bridge without a draw, the western approach to which would run nearly due west connecting with the Atchison & Nebraska Railroad in the Nemaha valley. In this opinion I had the hearty support of Mr. R. J. McClure, Chief Engineer of the Chicago, Burlington & Quincy R. R. and Mr. J. F. Barnard, then General Manager of the Hannibal & St. Joseph R. R. who really had been the first to call attention to the merits of Rulo as a place for crossing the Missouri River.

There was, on the other hand, a decided demand by some of the operating officials of the company for a low bridge, the west approach to connect with the old track of the Atchison & Nebraska R. R. in front of the town of Rulo, which ran south along the Missouri bottom till it reached the Nemaha valley. The merits of a high bridge scheme was its simplicity, a less cost of maintenance of the bridge and the fact that it shortened the through distance two miles. The only advantage of the low bridge scheme was that it avoided the deep cut west of Rulo, and a careful estimate showed that a low bridge would be the more expensive of the two. The difference in opinion prevented an early determination of the plan of bridge and did much to render the cost of real estate on the west side of the river unreasonably large.

In 1885 and before the character of bridge had been determined, I asked for authority to put in the foundation of Pier I (the eastern pier) with a view of determining more fully the character of the material on which the piers would rest. This authority was granted and work was actually begun December 3, 1885, this foundation being finished in the following April.

The character of the bridge was finally determined and the plans were submitted to the Secretary of War for approval July 19, 1886. No effort was made to get this approval quickly, and it was not finally received until February 25, 1887, work, however, had meanwhile been in progress.

In May 1886 authority was given to continue the construction of the bridge in earnest and the work was prosecuted from this time forward without delay under the direct charge of Mr. B. L. Crosby as Resident Engineer.

The winter of 1886-87 was unfavorable for work, it being one in which the ice formed and broke up several times, this causing some delay and increasing the cost of the work.

The last span of the bridge was swung September 24, 1887, and on the afternoon of October 2d the first locomotive crossed the bridge, and it was opened to traffic immediately thereafter.

The great cut on the west approach to the bridge was, however, not yet completed, and for nearly two years the traffic crossing the bridge was taken over the old line between Rulo and Rulo Y.

On June 3, 1889 the excavation for the great cut was completed, though the track remained to be laid and much ditching to be done; on July 14th the first train passed through the great cut. The ballasting of the track through the great cut was completed September 8th.

On November 1, 1889, the bridge with its approaches was turned over to the operating department as a completed structure.

II.

GENERAL DESCRIPTION.

The Rulo bridge is a single track railroad bridge. It consists of three channel spans each 375 feet long between centers of end pins, resting on four piers of granite masonry (numbered from east to west), at each end of which are three 125 feet deck spans, the spans being separated by iron towers 25 feet long, making the length of the iron structure at each end of the channel spans 425 feet. The end pins are placed 4 ft. 6 in. between centers over Piers II and III, and 3 ft. 6 in. between centers over Piers I and IV, and the end pin of the deck span is 1 ft. ½ in. from the back of the bolster, thus making the entire length of the whole structure from end to end of iron or steel work, 1993 feet 1 inch.

The bridge is built on a grade of 0.4 per cent. (21.12 ft. per mile) ascending westward. The clearance at the center of the east span was 53 feet above the water of April 14, 1884, and that at the center of the west span 56 feet above the same high water, this stage of high water being about six feet below the highest water observed except that of 1881; these clearances were both accepted in the approval of the plans by the Secretary of War. The actual clearances above the extraordinary flood of 1881, so far as this can be determined, are 43.5 and 46.5 feet respectively. Since the construction of this bridge, a Standard High Water has been established by the Missouri River Commission at this place (circular of April 24, 1889); the clearances above this high water are 50.8 and 47.8 feet respectively.

The east approach is 15,220 feet long from a connection with the track built by the St. Joseph & Nebraska R. R., in Section 36, T. 61 N., R. 40 W., to the end of the iron work, the maximum grade on this approach being 0.5 per cent. (26.4 ft. per mile.)

The west approach is 19,260 feet long from the west end of the iron work to the connection with the Atchison & Nebraska R. R., the maximum grades being 0.4 per cent. (21.12 ft. per mile) in each direction, excepting a short piece of one per cent. put in temporarily at the connection.

Besides the two approaches proper, a third approach, called the Atchison connection, was built connecting the west approach with the old line of the Atchison & Nebraska R. R., this connection being 1.36 miles long, with maximum grades of 1.5 per cent. (79.2 ft. per mile).

Pier IV the west pier stands on the edge of the river bank which is 530 feet distant from the base of the bluff, the intermediate ground being a piece of bottom land of about the elevation of high water, but which is composed so largely of the tough soil known as gumbo, that the action of the river upon it is very slow. The only protection required was a quantity of riprap revetment at Pier IV and extending a moderate distance above and below; this riprap must be carefully watched and may require extension sooner or later.

The only protection on the east side is the dike, which was the first work done in the construction of the bridge, and which has acted admirably.

All the levels taken during the construction of the bridge were tied to the benches established by the Missouri River Commission and referred to a tide water datum, this datum being 412.71 feet below the St. Louis City Directrix.

III.

SUBSTRUCTURE.

The substructure comprises the four granite piers which support the channel span and sixteen small cylindrical piers which support the towers which carry the deck spans. The principal piers are numbered from I to IV, Pier I beginning at the east end. These four piers are built on pneumatic caissons of the following dimensions:—

Pier I,	53	feet	long,	25	feet	wide	and	18	feet	high.
Pier II,	55	"	"	27	"	"	"	18	"	"
Pier III,	55	"	"	27	"	"	"	18	"	"
Pier IV,	53	"	"	25	"	"	"	30	"	"

All caissons were built with a side batter of one in twenty-four.

The foundations were put in by the company's own men under the direction of the Resident Engineer. The masonry was built by contract by the firm of Drake & Stratton.

The caisson for Pier I was built in a pit excavated on the dry sand bar on the east side of the river. The caissons for Piers II and III were built in position on pile false work and lowered with screws to the bottom of the river. The caisson for Pier IV was built in a pit excavated in the shore close to the river.

The pneumatic machinery was purchased from the Missouri Valley & Blair Railway and Bridge Co., and was the same machinery that had been used in sinking the foundations of the bridge at Blair crossing. The machinery was first set up on the east side of the river near the site of Pier I. Subsequently all of the machinery was transferred to the steamer John Bertram, which was purchased from the Sioux City & Pacific R. R., having been built to be used as a car transfer boat at Blair Crossing. This steamer arrived at Rulo May 28, 1886, and when equipped with the full outfit of pneumatic machinery, formed an admirable tool.

The caisson for Pier I was built of pine with an iron cutting edge and planked with two thicknesses of pine plank. The other caissons were built in the same way, except that the iron cutting edges were made heavier and the large sill timbers were of oak.

The caisson for Pier I is surmounted by 53 feet of crib work built in three sections and stepped down to 46 feet by 18 feet at the top of the upper section. The caissons for Piers II and III are surmounted by 42 feet of crib work built with the same batter as the caissons, but with the corners cut off so as to make the horizontal section that of an irregular octagon, the crib being sheathed with oak plank and the corners plated with 3-8 inch iron.

The caisson for Pier IV is surmounted by 50 feet of crib work 48 feet by 20 feet, the sides being plumb.

Both caissons and crib work were filled with Portland cement concrete.

The excavation of the pit for Pier I was begun December 3rd, 1885, the framing of the caisson December 14th and the setting up of the cutting edge January 15, 1886.

The caisson was finished February 13th and the concrete filling was begun February 18th. Air pressure was put on February 20th and on March 19th the caisson reached the clay at elevation 792.1. After sinking about four feet into the clay a test pit was begun March 30th and sunk 19.3 ft. through the first clay into the gravel which separated the upper clay from the lower clay and which at the site of this pier was only 3.4 feet thick. No increase of air pressure was required during the sinking of this test pit until the gravel was reached, and then it became necessary to increase the pressure at once to the full amount corresponding to the actual depth. This test pit showed the upper clay to be a perfectly homogeneous layer on which it was considered safe to found Piers I and IV, while it was thought best to sink Piers II and III to the lower clay. The test pit having served its purpose the excavation was filled up and the sinking of the caisson was continued till April 5th when an elevation of 785.88 was reached. The sealing of the working chamber was begun on the

following day and completed on the 9th of April, thus finishing the first foundation.

No further work was done on the foundation till after the high water season, when the first foundation taken in hand was Pier IV.

The excavation of the pit for Pier IV was begun July 15th, 1886; erection of the cutting edge on July 23rd and the caisson was completed and lowered on the ground August 17th. Concreting was begun August 19th and air put on this caisson August 22nd. The caisson reached the upper clay at elevation 799.2 September 9th. The clay, though identical in character with that found at Pier I, showed signs of having been disturbed. A test pit was sunk in this clay and while it was being sunk a horizontal crack was observed on which the upper portion moved over the lower portion about 1½ inches in a south easterly direction. It became perfectly evident that it was necessary to sink to lower clay, which was an expensive process. On the 19th of October a leak was discovered in the well leading to the air lock, and further trouble was experienced in the same way three days later, this defect being clearly due to bad workmanship. The caisson finally reached the lower clay on the 29th of October and on the 5th of November sinking was stopped at elevation 765.09 and sealing begun. The sealing was completed on the 8th of November and air let off on the following day.

No masonry was laid on either Pier I or IV until the completion of the foundation.

The first work done on Pier III was to drive a pile break water above the pier, which was begun September 11th, 1886, and this was immediately followed by the construction of the falsework. The erection of the caisson was begun October 9th and finished November 9th. Shallow water was obtained by sinking brush below the pile protection and thus forming a sand bar at the pier site. Meanwhile, a winter bridge had been built by the Operating Department about one quarter of a mile below the bridge line, and this bridge caused an ice pack which extended above the bridge line and caused very serious trouble. On the 24th of November the caisson was lowered until it floated on the water. Concreting was begun on the following day, but the trouble with ice prevented rapid progress. On the 28th of November all access to the pier was cut off by ice and a gang of thirty men were imprisoned there till the following morning. These difficulties were over on December 1st and the construction of the crib was begun, on the 4th of December air pressure was put on. The crib was finished January 9, 1887, its concrete filling January 11th, and masonry was begun January 14th. On the 6th of January the caisson had reached the first clay; on February 10th it had passed through the first clay and reached the gravel. The second clay was reached at elevation 766.9 on March 12th. From the 1st of March to March 10th it became necessary to abandon the foundation while the ice went out. On March 18th the foundation was again abandoned just as it was ready for sealing, and during the high water of the next two weeks, the pier was entirely submerged. On the 12th of April air pressure was again put on and it was found that the caisson had settled 1.14 ft. into the clay. In order to fit the courses of masonry it became necessary to sink 1.07 ft. further to elevation 763.53. On the 19th of April the sealing of the working chamber began and the foundation was finished on the 26th.

The first work done on Pier II was on the 5th of January 1887, when the driving of piles for the staging was begun. The erection of the cutting edge was begun on the 14th and the caisson was finished on February 5th; it was lowered on the 10th of February, landed on the 12th and air pressure put on on the 15th, the machinery on the Bertram supplying air for both Piers II and III and the sinking being continued in this way till the 23rd of February. Air pressure was again put on on the 18th of March; the crib and concrete filling were finished on the 8th of April, and the upper clay was reached on the 10th of April. The pier was abandoned April 12th so as to leave the steamer free to work on Pier III; work was resumed April 26th, and was then continued without interruption; the second clay was reached June 4th, the sealing of the working chamber began on the 10th, and this, the last foundation of the Rulo Bridge, was completed June 18th.

The sinking through clay was greatly facilitated by the use of a special air lock with an elevator arrangement attached by which the air pressure in the caisson was made to lift a bucket of clay to a lock above the masonry, which lock was worked entirely from the outside and when opened the bucket was dumped by the outside attendant. This special lock, known among the engineers as a "clay hoist" and among the workmen as a "go-devil" is shown in detail on Plate 10; the movement is precisely the same as that commonly used in hydraulic elevators, except that instead of water pressure, the air from the caisson was made available for power.

The full details of the four piers are given on Plates 4, 5, 6 and 7, and of the caissons on Plate 8. The rate of progress is shown graphically on Plate 9. Full records of the progress and details of sinking these foundations were kept and are given in Appendix D. The detail cost is given in Appendix E.

The cost of the four foundations is shown in detail in the table below.

This cost includes all concrete and other material below the masonry.

In this statement the item of freight charges is simply what is known as "company's freight" being freight on the lines of the C. B. & Q. R. R. system.

	Cost, excluding Freight Charges.	Freight Charges.	Cost, including Freight Charges.			
FOUNDATION I:						
CAISSON—						
Materials	$3,879.25	$ 569.53	$ 4,448.78			
Labor	1,928.17	—	1,928.17	$ 6,376.95		
CONCRETE FILLING—						
Materials	4,044.22	1,153.02	5,197.24			
Labor	1,536.99	—	1,536.99	6,734.23	$13,111.18	
CRIB—						
Materials	3,935.11	1,121.05	5,056.16			
Labor.	1,264.97	—	1,264.97	6,321.13		
CONCRETE FILLING—						
Materials	6,889.20	1,372.85	8,262.05			
Labor	2,306.13	—	2,306.13	10,568.18	16,889.31	
CUTTING EDGE, AIR-LOCK, SHAFTS, ETC.	2,124.96	303.44	2,428.40	—	2,428.40	
SINKING—						
Materials	1,184.76	297.64	1,482.40			
Labor	9,440.52	—	9,440.52		10,922.92	
ERECTION AND REMOVAL OF MACHINERY	1,999.85	—	1,999.85	—	1,999.85	
	40,534.13	4,817.53				$45,351.66
FOUNDATION II:						
CAISSON—						
Materials	3,314.51	1,053.24	4,367.75			
Labor	3,079.51	—	3,079.51	7,447.26		
FALSE WORK—						
Materials	1,051.86	291.12	1,342.98			
Labor	981.68	—	981.68	2,324.66		
CONCRETE FILLING—						
Materials	4,182.06	1,101.70	5,283.76			
Labor	3,169.65	—	3,169.65	8,453.41	18,225.33	
CRIB—						
Materials	2,648.81	860.87	3,509.68			
Labor	2,349.19	—	2,349.19	5,858.87		
CONCRETE FILLING—						
Materials	6,371.15	1,600.74	7,971.89			
Labor	3,896.89	—	3,896.89	11,868.78	17,727.65	
CUTTING EDGE, AIR-LOCK, SHAFTS, ETC.	3,850.65	344.34	4,194.99	—	4,194.99	
SINKING—						
Materials	2,001.54	557.63	2,559.17			
Labor	15,827.67	—	15,827.67		18,386.84	
ERECTION AND REMOVAL OF MACHINERY	549.86	—	549.86	—	549.86	
	$53,275.03	$5,809.64				$59,084.67

	Cost, excluding Freight Charges.	Freight Charges.	Cost, including Freight Charges.			
FOUNDATION III:						
CAISSON—						
Materials	$3,265.21	$ 983.55	$4,248.76			
Labor	4,077.20	—	4,077.20	$ 8,325.96		
FALSE WORK—						
Materials	785.97	119.91	905.88			
Labor	1,249.73	—	1,249.73	2,155.61		
CONCRETE FILLING—						
Materials	4,036.01	911.76	4,947.77			
Labor	3,317.58	—	3,317.58	8,265.35	$18,746.92	
CRIB—						
Materials	3,286.68	994.89	4,281.57			
Labor	2,664.74	—	2,664.74	6,946.31		
CONCRETE FILLING—						
Materials	7,253.66	1,274.60	8,528.26			
Labor	3,884.73	—	3,884.73	12,412.99	19,359.30	
CUTTING EDGE, AIR-LOCK, SHAFS, ETC.	4,256.63	315.89	4,572.52	—	4,572.52	
SINKING—						
Materials	2,223.83	537.71	2,761.54			
Labor	19,697.44	—	19,697.44		22,458.98	
ERECTION AND REMOVAL OF MACHINERY	520.59	—	520.59	—	520.59	
	60,520.00	5,138.31				$65,658.31
FOUNDATION IV:						
CAISSON—						
Materials	3,980.38	806.05	4,786.43			
Labor	2,551.45	—	2,551.45	7,337.88		
CONCRETE FILLING—						
Materials	4,092.87	550.00	4,642.87			
Labor	1,917.96	—	1,917.96	6,560.83	13,898.71	
CRIB—						
Materials	2,586.37	497.66	3,084.03			
Labor	2,134.96	—	2,134.96	5,218.99		
CONCRETE FILLING—						
Materials	7,088.43	1,329.03	8,417.46			
Labor	1,986.97	—	1,986.97	10,404.43	15,623.42	
CUTTING EDGE, AIR-LOCK, SHAFTS, ETC.	3,155.20	337.53	3,492.73	—	3,492.73	
SINKING—						
Materials	1,733.42	373.58	2,107.00			
Labor	15,047.99	—	15,047.99	—	17,154.99	
ERECTION AND REMOVAL OF MACHINERY	478.26		478.26	—	478.26	
	46,754.26	3,893.85				$50,648.11
GRAND TOTAL COST OF FOUR MAIN FOUNDATIONS	$201,083.42	$19,659.33				$220,742.75

It will be observed that the cost of the foundation of Pier III was $6,574 more than that of Pier II although the quantities of material are almost identical in the two piers, the extra cost being due to the interruption and other difficulties from ice and the incidental troubles connected therewith.

The contract for the masonry was let on July 23rd, 1886 to Geo. S. Field & Co. and transferred by them on the 2nd of August with my consent to the firm of Drake & Stratton. The dimension work is of granite quarried near St. Cloud, Minn.; the backing is of Anamosa limestone from Stone City, Iowa.

The specifications for the masonry are given in Appendix C.

The first stone laid was on Pier IV, the masonry of this pier being begun November 27th, 1886 and finished March 25th, 1887. The masonry of Pier III was begun January 14th, 1887 and completed May 19th, 1887. The masonry for Pier II was begun April 12th, 1887, and finished August 10th, 1887. The masonry for Pier I was begun April 19th, 1887 and completed August 9th, 1887.

The cost of masonry is shown in detail in the following table:

	PIER I.				PIER II.				PIER III.				PIER IV.			
Estimate—																
Masonry laid @ $27.40 per cubic yard	cu. yds. 561.80	—	—	$15,393.32	cu. yds. 128.59	—	—	$35,233.66	cu. yds. 1,317.00	—	—	$36,085.80	cu. yds. 814.40	—	—	$22,314.56
Labor—Replacing Course	—	—	—	—	—	—	—	9.10	—	—	—	5.30	—	—	—	—
Cutting and Drilling for Cramps	—	—	—	—	—	—	—	32.40	—	—	—	—	—	—	—	—
130 lbs. ¾ in. Round Iron for Cramps	—	—	—	—	—	—	—	3.90	—	—	—	—	—	—	—	—
Freight Charges on Stone	—	—	$655.09	—	—	—	$1,599.56	—	—	—	$1,515.69	—	—	—	$993.62	—
Freight Charges on Sand	—	—	126.23	—	—	—	289.93	—	—	—	295.91	—	—	—	182.95	—
	—	—	—	781.32	—	—	—	1,889.49	—	—	—	1,811.60	—	—	—	1,176.57
Eagle Cement @ $2.55 per bbl.	bbls. 107	$273.75	—	—	bbls. —	—	—	—	bbls. —	—	—	—	bbls. —	—	—	—
Freight Charges	—	100.57	—	—	—	—	—	—	—	—	—	—	—	—	—	—
			374.32													
Alsen Cement @ $2.70 per bbl.	24	64.80	—	—	202	$545.40	—	—	428	$1,155.60	—	—	389	$1,050.30	—	—
Freight Charges	—	10.34	—	—	—	100.43	—	—	—	254.76	—	—	—	191.77	—	—
			75.14				645.83				1,410.36				1,242.07	
Alsen Cement @ $2.80 per bbl.	26	72.80	—	—	187	523.60	—	—	—	—	—	—	—	—	—	—
Freight Charges	—	10.92	—	—	—	92.97	—	—	—	—	—	—	—	—	—	—
			83.72				616.57									
Alsen Cement @ $3.25 per bbl.	69	224.25	—	—	5	16.25	—	—	—	—	—	—	—	—	—	—
Freight Charges	—	9.90	—	—	—	.18	—	—	—	—	—	—	—	—	—	—
			234.15				16.43									
Dyckerhoff Cement @ $2.72 per bbl.	60	163.20	—	—	233	633.76	—	—	220	598.40	—	—	52	141.44	—	—
Freight Charges	—	29.77	—	—	—	115.85	—	—	—	130.96	—	—	—	25.63	—	—
			192.97				749.61				729.36				167.07	
				960.30				2,028.44				2,135.72				1,409.14
Total	—	—	—	$17,134.94	—	—	—	$39,196.99	—	—	—	$40,042.42	—	—	—	$24,900.27
Cost per Yard of Masonry	—	—	—	30.50	—	—	—	30.48	—	—	—	30.40	—	—	—	30.57
Average Cost per Yard of Masonry	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	30.49

The total cost of the four piers including the foundations and masonry is given in the following table:

	Cost, excluding Freight.			Freight Charges.			Cost, including Freight.			Gross Volume.	Cost per Cubic Ft.	Cu. Ft. Sunk (Area of base × feet sunk.)	Cost per Cubic Ft.	Vertical Ft. Sunk below Standard Low Water.	Cost per Vertical Foot.
										Cubic Feet.	Cents.		Cents.		
FOUNDATION I:															
Caisson and Filling	$13,513.59	—	—	$2,025.99	—	—	$15,539.58	—	—	23,093.16	67.3				
Crib and Filling	14,395.41	—	—	2,493.90	—	—	16,889.31	—	—	53,508.12	31.5				
Sinking Caisson	10,625.28	—	—	297.64	—	—	12,922.77	—	—	—	—	760.02	16.6	57.36	$220.10
Erection and Removal of Machinery	1,999.85														
		$40,534.13			$4,817.53			$45,351.66							
FOUNDATION II:															
Caisson and Filling	19,629.92	—	—	2,790.40	—	—	22,420.32	—	—	25,930.31	86.4				
Crib and Filling	15,266.04	—	—	2,461.61	—	—	17,727.65	—	—	45,764.09	38.7				
Sinking Caisson	17,829.21	—	—	557.63	—	—	18,936.70	—	—	—	—	115,488.45	15.9	77.77	236.34
Erection and Removal of Machinery	549.86														
		53,275.03			5,809.64			59,084.67							
FOUNDATION III:															
Caisson and Filling	20,988.33	—	—	2,331.11	—	—	23,319.44	—	—	25,930.31	89.9				
Crib and Filling	17,089.81	—	—	2,269.49	—	—	19,359.30	—	—	40,015.00	42.1				
Sinking Caisson	21,921.27	—	—	537.71	—	—	22,979.57	—	—	—	—	118,369.35	19.0	79.71	281.76
Erection and Removal of Machinery	520.59														
		60,520.00			5,138.31			65,658.31							
FOUNDATION IV:															
Caisson and Filling	15,697.86	—	—	1,693.58	—	—	17,391.44	—	—	27,368.21	63.5				
Crib and Filling	13,756.73	—	—	1,826.69	—	—	15,623.42	—	—	49,963.36	31.5				
Sinking Caisson	16,781.41	—	—	373.58	—	—	17,633.25	—	—	—	—	103,548.75	16.6	78.15	219.51
Erection and Removal of Machinery	478.26														
		46,754.26			3,893.85			50,648.11							
COST OF FOUNDATIONS	—	—	$201,083.42	—	—	$19,659.33	—	—	$220,742.75						
MASONRY PIER I	—	16,192.12	—	—	942.82	—	—	17,134.94							
" " II	—	36,998.07	—	—	2,198.92	—	—	39,196.99							
" " III	—	37,845.10	—	—	2,197.32	—	—	40,042.42							
" " IV	—	23,506.32	—	—	1,393.67	—	—	24,900.27							
			114,541.59			6,733.03			121,274.62						
TOTAL COST OF MASONRY															
TOTAL COST OF FOUR PIERS,	—	—	$315,625.01	—	—	$26,392.36			$342,017.37						

The towers which carry the approach spans are supported on brick piers, the plans of which are given on Plate 12. An excavation was made at the site of each pier in which nine piles were driven; a further excavation was then made around the piles and filled with concrete. In this concrete was buried an annular washer from which six anchor rods extended upwards. The pier was then built up with hard brick laid in Portland cement mortar around the rods and surmounted with a wrought iron cap plate. Another annular washer was then placed on this cap plate and the rods screwed up till an initial strain of five tons was obtained in each rod; the cap plate, which was formed of a plate and a circular channel iron was then filled with Portland cement concrete; a second cap plate was then put on top and the whole riveted up. The design was based on the principle that the tension in the rods would always keep the brick work under strain and so prevent its jarring loose. These piers were built by the day by the company's own men, the total cost of the 16 piers being $23,264.66 of which $1,479.55 was for freight.

The amount of masonry and concrete in the entire bridge is as follows:

	MASONRY. Cubic Yards	BRICK. Cubic Yards	CONCRETE. Cubic Yards	TOTAL.
Pier I	561.8		2,109.8	2,671.6
Pier II	1,285.9		1,986.1	3,272.0
Pier III	[illegible]		[illegible]949.0	3,266.0
Pier IV	814.4		2,267.0	3,081.4
16 Small Piers		263.8	276.7	530.5
Total	[illegible]	263.8	8,578.6	12,821.5

The total cost of the substructure was then as follows:

Four Main Piers	$342,017.37
Sixteen Small Piers	23,264.66
	$365,282.03

The east end of the east deck span rests on a timber pier around which the embankment has now been filled; the west end of the west approach span rests upon a concrete block resting on the embankment and allowed to settle with the embankment, the end of the span being raised as settlement occurs. Both the timber pier and the concrete block have been treated in the accounts as parts of the approaches, though this distribution is not strictly correct.

IV.
SUPERSTRUCTURE.

The superstructure consists of three through spans and six deck spans, three at each end.

Each through span is 375 feet long between centers of end pins, fifty feet deep and twenty two feet between centers of trusses. Expansion is provided at the west end of every span, that is at the upper end, the bridge being on a grade.

Each deck span is 125 feet long between centers of end pins, 17 feet 6 inches deep, the trusses placed 12 feet between centers. The spans are separated by iron towers 25 feet long, thus making each set of deck spans with intermediate towers a continuous structure 425 feet long, divided into 17 equal panels of 25 feet each. The trusses are fastened rigidly to the posts which form the towers; expansion is provided at each end of the 425 feet, the expansion of the central span being taken out by the spring of the towers.

Proposals were invited from a number of prominent bridge builders and on the 2d of August 1886 the contract for the superstructure was closed with the Edgemoor Iron Co., by whom the entire work was manufactured. With my approval the Edgemoor Iron Co. sub-let the erection to the firm of Baird Bros., and it was done under the immediate direction of Mr. Andrew Baird.

The through spans are of the double system Whipple type, the trusses being divided into 15 panels of 25 feet each. The top chord, end posts, eye bars, floor beams, rods, bolsters, rollers, rail-bearing plates and pins are of steel. All other parts are of wrought iron except the heavy wall plates resting on the masonry, washers and ornamental work, which are of cast iron. The details of these spans are given on Plates 14, 15, 16, 17 and 18.

The deck spans are of the single system Whipple type. The pins, rollers, rail-bearing plates and eye bars are of steel. The other portions are of wrought iron except the heavy wall pedestals, which are of cast iron. The details of these spans are given in Plates 19 and 20.

The trusses of the long spans were proportioned to carry a uniform moving load of 3000 lbs. per lineal foot of bridge, the effect of a moving load in excess of that due to a uniform load of equal intensity being estimated on the basis of 5000 lbs. per foot.

The floor system is proportioned for a total load of 6000 lbs. per lineal foot of track. The top lateral system is proportioned to resist a wind pressure of 300 lbs. per lineal foot and the bottom lateral system a wind pressure of 500 lbs. per lineal foot. The computed strains are given on Plate 22.

The deck spans are proportioned for a total load of 5000 lbs. per foot, all treated as moving load.

The steel compression members in top chords and end posts are made as nearly as possible of symmetrical section, the metal in the top cover plate being practically the same as in the two balance plates and the lacing below. The compression strains on these members was limited to 15,000 lbs. per square inch of net section, the net section being obtained by deducting from the gross section the amount by which the cover plate exceeds the balance plates. The tensile strain in the bottom chord was limited to 14,000 lbs. per square inch and somewhat less in the web members.

In the approach spans the tensile strain on steel was limited to 13,000 lbs. per square inch, the largest strain being in the center panel of the bottom chord.

The weights of iron and steel in the through spans are as follows:

	[illegible] Spans.		Average per Span.	
	lbs	lbs	lbs	lbs
Steel		1,554,168		518,056
Wrought Iron in Trusses	860,127		286,709	
Wrought Iron in Floor	483,867		61[illegible]	
Total Wrought Iron		1,343,994		447,998
Cast Iron		60,056		20,019
Total		2,958,218		986,073

The weights of iron and steel in the deck spans are as follows:

	[illegible] Spans.		Average per Span.	
	lbs	lbs	lbs	lbs
Wrought Iron in Trusses	343,513		57,319	
Wrought Iron in Floor	[illegible]761		46,378	
Total Wrought Iron		622,179		103,697
Cast Iron	—	7[illegible]		1,182
Total		799,652		133,275
Four Towers		213,441		
Total		1,013,093		

The specifications under which the superstructure was manufactured are given in Appendix F.

The steel was all open hearth steel, the total number of melts used being 161, made by the following parties:

Cambria Iron and Steel Co.	82	melts
Carnegie, Phipps & Co., Limited	52	"
Pennsylvania Steel Co.	5	"
Pittsburgh Steel Casting Co.	22	"

The work was manufactured by the Edgemoor Iron Co. at its works near Wilmington, Dela.

The first set of eye bars tested did not meet the requirements of the specifications, a considerable number of them breaking in the head; it seemed probable, however, that the breakage was not due to any defect in the bars, but to the fact that the machine was not strong enough to break them and that its own failings caused irregular strains. I therefore thought best to open the question anew and make the rejection of the bars depend on a second set of tests to be made in the large testing machine at Athens, Penna.; the results of these tests are given in Appendix G and on these tests the eye bars were accepted.

The trusses were erected on pile false work, a large traveler taking the place of upper false work. Thedates a t which the several parts were erected is shown in the following table:

	First Iron Placed.	Span Swung
East Approach Spans	Sept. 4, 1887.	Sept. 14, 1887
Span I-II	Sept. 18, 1887.	Sept. 24, 1887
Span II-III	Aug. 14, 1887.	Aug 18, 1887
Span III IV	May 21, 1887.	May 27, 1887
West Approach Spans	April 13, 1887.	July 20, 1887

The last span would have been swung three days earlier but was delayed waiting for material.

The timber floor was placed on the superstructure by the company's own men, working under the direction of the Resident Engineer. The painting was also done by the company's own men working under the direction of the Resident Engineer.

The total cost of the superstructure is given in the following table:—

THROUGH SPANS.			
Iron, Steel and Ornamental Work	$103,827.91		
Freight Charges on same from Chicago	4,001 34		
		$107,829 25	
Labor,—Erection	-	29,730.00	
Miscellaneous Material: Cement, Iron Borings, Sal {Ammonia, Sulphur		57 75	
			$137 617 00
DECK SPANS.			
Iron and Steel	33,854.76		
Freight Charges	1,442.40		
		35,297 16	
Labor—Erection		4,459.00	
Filling Castings	—	13.85	
Jacking up End of Spans	—	31 81	
Boxing Bars	—	18 00	
Switching Charges	—	75	
Miscellaneous Materia.: Iron Borings, Sal Ammonia &c.	—	55 84	
			41,918 41
FLOOR.			
Material	—	7,771.23	
Freight	—	1,920.48	
Labor	—	1,802 12	
			11,495 83
PAINTING.			
Material	—	1,340 95	
Labor	—	4 107 87	
			5,448.82
Total Superstructure,	—	—	$196,480.06

V.

APPROACHES.

The east approach to the Rulo Bridge is 2.88 miles long from the con nection with the track of the St. Joseph & Nebraska R. R. to the east end of the iron work. Of this approach the 2000 feet next to the bridge was built originally as a timber trestle and subsequently filled in with material hauled from the great cut on the west approach. The remainder of the approach was built as an earth embankment, the material being generally borrowed from the sides, though a portion of the higher embankment was taken with a steam shovel from a pit in the bottom land. The total amount of earth in this Approach is as follows:—

Borrowed from sides	229,853 cubic yards.
Borrowed from steam shovel pit	150,775 " "
Hauled from west side	326,970 " "
Total	707,598 cubic yards

The west approach is 3.64 miles long from west end of the iron work to the connection with the Atchison & Nebraska track in the Nemaha bottom. There are on this Approach three cast iron pipe culverts and four small trestles having an aggregate length of 495 feet. All the remainder is earth work the total quantity being as follows:

Earth excavation hauled to east side		326,970 cubic yards.
" " used in embankment		240,173 " "
" " wasted		32,358 " "
" " borrowed		44,340 " "
Rock		2,700 " "
Total		646,541 cubic yards

These quantities include an extra width of grading for a distance of 1200 feet at the Rulo station grounds.

The Atchison connection is 1.36 miles long leading southward from the west approach, with which it connects 760 feet from the west end of the iron work. There is a trestle 680 feet long in the town of Rulo, and a pile trestle 48 feet long near the connection with the old track, the remainder of the line being earthwork. The amount of material handled on this line was 42,718 cu bic yards.

The alignment and gradients on the Approaches are shown on Plate 2.

The contract for the earthwork of the Approaches was let May 19, 1886, to S. Dwight Eaton, of Burlington, Iowa. This contract covered both the East and West Approaches and the Atchison connection; it was not signed till June 26, 1886.

Grading was begun on the Atchison connection June 18, 1886, on the West Approach June 22d and on the East Approach July 13, 1886. The line from the east end of the great cut to the connection with the Atchison & Nebraska track was not built till after the bridge was opened, the line to the west being made by way of the Atchison Connection, trains running backwards between Rulo Station and Rulo Y, although the bridge was opened for traffic on the 2d of October.

No earth was taken across the river from the great cut till November 23, 1887. More than seven weeks of the best season of the year being lost through unnecessary delays; from that time forward the work was handled with rather more efficiency and the entire West Approach was completed and ready for the track on June 3d, 1889.

The great cut has a maximum depth of 82 feet. It is excavated through material of a mixed character, it being generally a sandy clay but containing some masses of hard blue clay and pockets of sand, these pockets of sand were generally filled with water, which water ran out when the excavation was made and did not reappear. The bottom of the cut is formed everywhere of hard clay, excepting near the summit at the west end. The cut was laid out with a 50 foot base with slopes of one horizontal to two vertical. In some instances these slopes were slightly increased, and some of the material was left in the base so that the finished width was generally not more than 40 feet. The cut was thoroughly ditched, left of sufficient width to be kept clean permanently, and the track was thoroughly ballasted. The character of the material, however, in this cut is such that it will require constant attention for a number of years in keeping the ditches clean, so as to avoid saturating the material in the sides of the cut by standing water; I regret to say that this has not been properly attended to since the work was completed.

A line nine tenths of a mile long was built connecting the East Approach with the dike above the bridge, the only object being to make a convenient line of access in case any repairs should be needed after the old tracks on the east side should be taken up; this line has at the east end a grade of three per cent. 158.4 ft. per mile.

VI.

PROTECTION WORK.

The principal protection work is the dike on the east side. The position and plans of this dike are shown on Plate 23. The foundation of the dike was made of a woven willow mattress 125 feet wide, extending 100 feet inside and 25 feet outside of the center line of the track laid on the dike. On this as a foundation was built an embankment of brush and rock, which was carried to an elevation of 856 and on which a track was laid. This dike was built by the company's own forces in the winter of 1884 '85.

The dike was subsequently extended 700 feet down stream to Pier I by a permeable screen made by driving a series of piles through a woven mattress 50 feet wide and subsequently putting another mattress on the outside of the piles the lower edge resting on the first mattress and the upper edges wired to the piles. The effect of this screen was to allow the river to permeate through the screen so that there would be a current on both sides of the screen and thus entirely prevent the formation of an eddy at the lower end of the dike.

The dike worked perfectly, and during the high water season of 1885, a deposit was formed below it nearly as high as the top of the dike. A good growth of willows now covers the ground between the dike and the bridge line.

There was used in the construction of the dike 3571 cords of brush, 8712 tons of riprap stone, 2273 feet of piles and 4223 lbs. of wire.

The only protection work done on the west side was to riprap the shore in the neighborhood of Pier IV; for this 2530 tons of stone were used

VII.

COST.

The cost of the bridge and approaches is given in the following table:

	Cost exclusive of Freight Charges			Freight Charges		Cost including Freight		
Protection East Shore	$ [illegible]		$4,028 63			$18,523.65		
Protection West Shore	[illegible]		[illegible]			3,005 37		
Total Protection		$10,543 [illegible]			$4,985 [illegible]			$ 21,528.92
Foundation Pier I	40,534.13		[illegible]			45,351 66		
Foundation Pier II	53,275 03		5,[illegible]			5,[illegible]		
Foundation Pier III	60,520 00		5,[illegible]			[illegible]		
Foundation Pier IV	46,754.36		3,893 85			50,[illegible]		
Total Foundations		$201,083 42		$19,659.33			$220,742 75	
Masonry Pier I	[illegible]		942.82			17,134.94		
Masonry Pier II	36,998.07		2,198.92			39,196.99		
Masonry Pier III	37,845 10		2,197.32			40,042 [illegible]		
Masonry Pier IV	[illegible]		1,393.97			24,900.37		
Total Masonry		114,541.59		6,733.03			121,274 [illegible]	
Approach Piers		21,786.11		1,478 55			23,264 66	
Total Substructure			337,411.12		27,870 91			365,282.03
Through Spans	133,615.66			4,001 91		137,617.00		
Deck Span	[illegible]			1,432 46		11,[illegible]		
Bridge Floor	10,[illegible]			92 [illegible]		11,[illegible]		
Painting	[illegible]					[illegible]		
Total Superstructure			190,113.84		6,366 22			196,480.06
East Approach, Grading and Masonry	74,813 56			[illegible]		77,694.76		
East Approach, Trestle	18,907.68			3,242.79		[illegible]		
West Approach, Grading and Masonry	151,481.64			6,[illegible]		158,009.72		
West Approach, Trestle	[illegible]			403.68		3,932.11		
Atchison Connection, Grading and Masonry	8,[illegible]			70.67		8,702.79		
Atchison Connection Trestle	6,966 34			390.11		7,356.45		
Permanent Track	72,705 99			4,319.91		77,025 90		
Total Approaches			336,975.16		17,796.44			354,771.60
Service Tracks,	14,314.16			680.58		14,994.74		
Tools and Machinery	12,337.42			1,[illegible]		13,[illegible]		
Buildings	3,800.51			197.69		[illegible]		
			30,442.09		2,345.38			32,787.47
Engineering Salaries	45,400.64					45,400.64		
Engineering and Office Expenses	4,134.03					4,134.03		
			49,534.67					49,534 67
Total cost			$961,020 32		$ 59,364.43			$1,020,384.75

The item of freight includes freight only over the C. B. & Q System. In comparing the cost of this bridge with that of other structures the cost without freight forms the most correct basis for comparison

This table may be condensed into the following:

	Cost exclusive of Freight Charges	Freight Charges	Cost including Freight Charges
Substructure	$337,411 12	$27,870 91	$365,282.03
Superstructure	190,113.84	6,366 22	196,480 06
Total Bridge [illegible]	[illegible]	34,237 13	561,762 09
Protection Works	16,543 44	4,985 48	21,528.92
Approaches	336,975.16	17,796 44	354,771.60
Service Tracks, Tools and Buildings	30,442 09	2,345 38	32,787.47
Engineering and Expenses	49 534.67		49,534 67
Total Cost	$961,020 32	$59,364.43	$1,020,384 75

This is the total cost of the Rulo bridge and approaches as built under my charge; the following additional items have, however, been charged to the cost of the bridge:

Land Damages	$46,721.35
Watching	5,296.91
Preliminary Expenses	340.25
Rulo Yard	98 34
	$52,456 85

Which makes the total cost $1,072,841.60. Against this the construction cost is really entitled to a considerable credit for the amount of abandoned line on each side of the river. The item of watching covers the 25 months from October 1, 1887 to November 1, 1889, during which whole period the bridge was in use.

APPENDIX A.

LIST OF ENGINEERS, CONTRACTORS AND EMPLOYEES.

ENGINEERS AND COMPANY'S EMPLOYEES.

NAME AND OCCUPATION.	TIME OF SERVICE
Geo. S. Morison, Chief Engineer.	
Benjamin L. Crosby, Resident Engineer	Sept. 13, 1883, to Dec. 31, 1889
Edwin Duryea, Jr., Assistant Engineer	Mar 22, 1886 " Nov. 21, 1886
Mark A. Waldo, Assistant Engineer	May 29, 1886, " June 16, 1887
W. S. Macdonald, Assistant Engineer	Aug. 9, 1886, " Feb. 25, 1889
A J. Himes, Assistant Engineer	July 7, 1888, " Oct. 31, 1889
W. R. Johnson, Rodman	Nov 17, 1885, " Oct. 31, 1889
J. M. Richardson, Clerk	July 18, 1886, " Oct. 31, 1889
R. F. Thayer, Timekeeper	June 23, 1886, " Aug. 13, 1887
E. P Butts, Inspector of Stone at Quarries	Sept 1, 1886, " July 15, 1887
John Naegeley, Inspector of Superstructure	Sept. 20, 1886, " Oct. 6, 1887
Paul Willis, Assistant Inspector of Superstructure	Dec 15, 1886, " July 13, 1887
P. H Aylward, Supt. Pressure Work	Feb 12, 1886, " Sept. 1, 1887
Charles Connor, Master Mechanic	Dec 10, 1885, " July 23, 1887
J. Rick, Foreman of Carpenters,	Dec 11, 1885, " May 13, 1886
S. S. Warrington, Foreman of Carpenters	June 10, 1886, " Apr. 7, 1888.
Birton Reed, Inspector of Masonry	Nov 19, 1886, " Feb. 25, 1887
Charles Stears, Inspector of Masonry	May 4, 1887, " July 18, 1887
John Newman, Foreman of Laborers	Nov 28, 1884, " Feb. 25, 1887

CONTRACTORS.

NAME.	NATURE OF WORK.
Drake & Stratton	Masonry.
James Doig, Supt. at Rulo.	
Edgemoor Iron Co.	Superstructure.
Baird Bros., Sub-Contractors for Erection	
S. Dwight Eaton	Grading Approaches.
J. S. Wattles	East Approach Trestle.

APPENDIX B.

ACT OF JUNE 18, 1884, AUTHORIZING CONSTRUCTION OF RULO BRIDGE AND CONTRACT WITH WAR DEPARTMENT.

An act to authorize the construction of a bridge across the Missouri River at some accessible point within ten miles north and ten miles south of the town of Rulo, in the county of Richardson, in the State of Nebraska.

BE IT ENACTED BY THE SENATE AND HOUSE OF REPRESENTATIVES OF THE UNITED STATES OF AMERICA IN CONGRESS ASSEMBLED:—

That the Atchison and Nebraska Railway Company, an incorporation organized under the laws of the State of Nebraska, is hereby authorized to construct and maintain a bridge across the Missouri River at such a point as may be hereafter selected by said corporation within ten miles north and ten miles south of the town of Rulo, in the county of Richardson, in the State of Nebraska, as shall best promote the public convenience and welfare and the necessaries of business and commerce, and also to construct accessory works to secure the best practicable channel-way for navigation and confine the flow of the water to a permanent channel at such point, and also to lay on and over said bridge a railway track for the more perfect connection of any railroads that are or shall be constructed to said river at or opposite said point; and said corporation may construct and maintain ways for wagons, carriages, and for foot-passengers, charging, and receiving reasonable toll therefor as may be approved from time to time by the Secretary of War.

SEC. 2. That said bridge shall be constructed and built without interference with the security and convenience of navigation of said river beyond what is necessary to carry into effect the rights and privileges hereby granted; and in order to secure that object the said company or corporation shall submit to the Secretary of war, for his examination and approval, a design and drawings of the bridge, and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, the shore-lines at high and low water, the direction and strength of the currents at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be built:

PROVIDED, That if the said bridge shall be made, with unbroken and continuous spans, it shall have three or more channel spans, and shall not be of less elevation in any case than fifty feet above extreme high-water mark, as understood at the point of location, to the bottom chord of the bridge, nor shall the spans of said bridge be less than three hundred feet in length, and the piers of said bridge shall be parallel with the current of said river, and the main span shall be over the main channel of the river, and not less than three hundred feet in length:

AND PROVIDED ALSO, that if any bridge built under this act shall be constructed as a draw-bridge, the same shall be constructed as a pivot-bridge, with a draw over the main channel of the river at an accessible and navigable point, and with spans of not less than one hundred and sixty feet in length in the clear on each side of the central or pivot pier of the draw, and the next adjoining span or spans to the draw shall not be less than three hundred feet, and the head room under such span shall not be less than ten feet above high water mark.

PROVIDED ALSO, That said draw shall be opened promptly upon reasonable signal for the passing of boats; and said company or corporation shall maintain, at its own expense from sunset till sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe:

PROVIDED ALSO, That all railway companies desiring to use said bridge shall have and be entitled to equal rights and privileges in the passage of the same, and in the use of the machinery and fixtures thereof, and of all the approaches thereto, under and upon such terms and conditions as shall be prescribed by the Secretary of War, upon hearing the allegations and proofs of the parties, in case they shall not agree.

SEC. 3. That the Secretary of War is hereby authorized and directed, upon receiving such plan and map and other information, and upon being satisfied that a bridge built on such plan and with such accessory works and at such locality will conform to the prescribed conditions of this act, to notify the company that he approves the same, and upon receiving such notification the said company may proceed to an erection of said bridge, conforming strictly to the approved plan and location; and should any change be made in the plan of the bridge or said accessory works, during the progress of the work thereon such change shall be subject likewise to the approval of the Secretary of War; and in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river caused or alleged to be caused by said bridge, the case may be brought in the circuit court of the United States of the State of Nebraska or State of Iowa in which any portion of said obstruction or bridge may be located.

SEC. 4. That the said bridge and accessory works, when built and constructed under this act and according to the terms and limitations thereof, shall be lawful structures; and said bridge shall be recognized and known as a post-route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States than the rate per mile paid for the transportation over the railroads or public highways leading to said bridge; and said bridge shall enjoy the rights and privileges of other post routes in the United States; and Congress reserves the right at any time to regulate by appropriate legislation the charges for freight and passengers over said bridge.

SEC. 5. That the United States shall have the right of way for such postal-telegraph lines across said bridge as the Government may construct or control.

SEC. 6. That Congress shall have power at any time to alter, amend, or repeal this act so as to prevent or remove all material and substantial obstructions to the navigation of said river by the construction of said bridge and its accessory works; and the expense of altering said bridge or removing such obstructions shall be at the expense of the owners of or persons controlling such bridge.

Received by the President, June 6, 1884.

(NOTE BY THE DEPARTMENT OF STATE. The foregoing act having been presented to the President of the United States for his approval, and not having been returned by him to the House of Congress in which it originated within the time prescribed by the Constitution of the United States, has become a law without his approval.)

CONTRACT.

WHEREAS, By an Act of Congress of June 18, 1884,—23 Stats. 45 — entitled, "An Act to authorize the construction of a bridge across the Missouri River at some accessible point within ten miles north and ten miles south of the town of Rulo, in the county of Richardson, in the State of Nebraska," it was enacted that the Atchison & Nebraska Railway Company, an incorporation organized under the laws of the State of Nebraska, is hereby authorized to construct and maintain a bridge across the Missouri River at a point within ten miles north and ten miles south of the town of Rulo, in the county of Richardson, in the State of Nebraska, and to construct accessory works to secure the best practicable channel-way for navigation, and also to lay on and over said bridge a railway track, to construct and maintain ways for wagons, carriages and foot passengers, charging and receiving reasonable toll therefor as may be approved from time to time by the Secretary of War, and

WHEREAS, It was further enacted by the Act of Congress aforesaid, that the said bridge shall be constructed and built without interference with the security and convenience of navigation of said river beyond what is necessary to carry into effect the rights and privileges hereby granted; and in order to secure that object the said company or corporation shall submit to the Secretary of War for his examination and approval, a design and drawings of the bridge, and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, the shore lines at high and low water, the direction and strength of the currents at all stages, and the soundings, accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War, the bridge shall not be built, and

WHEREAS, The Secretary of War is authorized and directed by said Act of Congress, upon receiving such plan and map and other information, and upon being satisfied that a bridge built on such plan and with such accessory works and at such locality will conform to the prescribed conditions of said Act, to notify the company that he approves the same, and

WHEREAS, The Atchison and Nebraska Railway Company in accordance with the provisions of the Act of Congress aforesaid, has submitted to the Secretary of War for examination and approval its design and drawing of the said bridge, and a map of the location of the same, as by said Act of Congress required, and

WHEREAS, The Chief of Engineers, United States Army, has reported, "That from the best and most reliable information attainable by this office, contained in the papers herewith, it is believed that the plans of the bridge at Rulo are substantially in accordance with the requirements of the Act of Congress" aforesaid.

NOW THEREFORE, I, William C. Endicott, Secretary of War, having examined and considered the plan and location of the bridge submitted by the said Atchison and Nebraska Railway Company, as aforesaid, which said plan and map of location are hereto attached and form part of this instrument, do hereby approve the same.

But it is understood and agreed that this approval is given upon the express conditions following:—

1. That the said bridge shall be erected at the point indicated in the map of location submitted, and be constructed in accordance with the provisions of said Act of Congress, and the plan submitted and attached as aforesaid.

2. That should any change be made in the plan of said bridge during the progress of construction such change shall be subject to the approval of the Secretary of War.

Witness my hand this 25th day of February, 1887.

WM. C. ENDICOTT, Secretary of War.

This instrument is also executed by the Atchison and Nebraska Railway Company, by its President G. W. Holdrege, thereto lawfully authorized this 12th day of February, 1887, in testimony of its acceptance of the provisions of the said Act of Congress, and the conditions therein imposed.

THE ATCHISON AND NEBRASKA RAILWAY CO.

In presence of

THOS. MILLER,
WM. A. HIGGINS,
C. D. DORMAN.

G. W. HOLDREGE, President

Attest,
J. C. TAYLOR, Secretary.

APPENDIX C.

SPECIFICATIONS FOR MASONRY.

There will be four piers, numbered from east to west. Piers I and IV will be within the shore lines, and will contain approximately 550 and 800 cubic yards of masonry. Piers II and III will be in the river, and will contain approximately 1,300 cubic yards each. The masonry of Piers I and IV will be started on finished concrete foundations, and above the surface of the water. The masonry of Piers II and III will rest on foundations put in by the plenum pneumatic process, the bottom of the masonry finishing about twelve feet below low water, and about twenty-five feet of masonry having to be laid while the sinking of the foundations is in progress.

The masonry will be first-class rock face work, laid in regular courses. The face stones, including coping, will be of granite, which shall be of uniform character throughout, and acceptable to the Engineer. The backing may be of any good, sound limestone.

The piers shall conform in all respects to the plans furnished by the Engineer.

No course shall be less than sixteen inches thick, and no course shall be thicker than the course below it. The upper and lower beds of every stone shall be at least one quarter greater in both directions, than the thickness of the course, and no face stone shall measure less than thirty inches in either horizontal direction. In general, every third stone of each course shall be a header, and there shall be at least two headers in each course between the shoulders. No stone will be considered a header that measures less than five feet from the face. The headers shall be so arranged as to form a bond entirely through the pier, either by bonding against a face stone in the opposite side of the course, or by bonding with a piece of backing not less than three feet square which shall bond with a face stone on the opposite side. In all cases the interior bonding shall be further secured by placing in the course above, a stone of the full thickness of the course, and at least three feet square, over the interior joints. Special care shall be taken with the bonding of the ice breaker cut water, the stones of which shall be so arranged that the face stones are supported from behind by large pieces of backing.

All joints shall be pitched to a true line, and dressed to one quarter of an inch for at least twelve inches from the face. Beds, both upper and lower, shall be pitched to a true line, and dressed to one quarter of an inch. Joints shall be broken at least fifteen inches on the face. The bottom beds shall always be the full size of the stone.

The pointed up stream starlings of Piers II and III, from the footing courses to the small coping at the offset, shall have a fine pointed face, with no projection exceeding one-half inch from the pitch line of the joints. There shall be a draft line three inches wide, around the lower edge of the belting course below the coping, and on the edge of the pointed starlings. The entire coping over the whole pier, and the small copings over the starlings, shall have smooth bush-hammered surfaces and faces. All other parts of the work shall have a rough quarry-face, with no projection exceeding three inches from the pitch line of the joints.

The face stones of each entire course of Piers II and III above the footing courses and below the offset at the top of the pointed starlings, shall be doweled into the course below with round dowels of one and one-eighth inch iron, extending six inches into each course. The dowels shall be from eight to twelve inches back from the face and six inches on each side of every joint, the stones of the upper course shall be drilled through before setting after which the drill-hole shall be extended six inches into the lower course a small quantity of mortar shall then be put into each hole, the dowel dropped in and driven home, and the hole filled with mortar and rammed. The three courses below the coping shall have the joints bound with cramps of ⅝" round iron, twenty inches long between the shoulders, the ends sunk three inches into each stone.

The stones in the coping under the bearings of the trusses shall be according to special plans, to be furnished. They shall have good beds for their entire size, and shall have a full bearing on large stones with dressed beds in the bolting course below the coping.

The stones of the backing shall have dressed beds. The backing shall generally be of the same thickness as the face stones, but two thicknesses of backing may be used for one course of face stones, provided no backing is less than twelve inches thick.

All stones shall be sound, free from seams, and other defects, and the quarries shall be approved by the Engineer. All limestone shall be laid on natural beds.

All stones shall be laid in full mortar beds. They shall be lowered on the bed of mortar, and brought to a bearing with a maul. No spalls will be allowed, except in small vertical openings in the backing. Thin mortar joints will not be insisted on, but the joints shall be properly cleaned on the face and pointed in mild weather, the pointing to be driven in with a caulking iron.

The mortar will be composed of cement and clean, coarse sand, satisfactory to the Engineer, in proportions varying from one to three parts of sand to one of cement, as may be directed by the Engineer, for different parts of the work. When the stone is laid in freezing weather the contractor shall take such precautions to prevent the mortar from freezing as shall be satisfactory to the Engineer.

No material shall be measured, nor included in estimates, which does not form a part of the permanent structure.

The Railroad Company will furnish free transportation from Kansas City or Council Bluffs, or any intermediate point on the K. C., St. J. and C. B. R. R. to the bridge site, for stone actually used in the piers. Free transportation will also be furnished from any approved limestone quarry in Nebraska, not more than 75 miles from Rulo, on a railroad operated by the C. B. & Q. R. R. Co. This free transportation is given on the assumption that the stone is to be cut at the quarry, and if the contractors prefer to cut at the bridge site, a charge will be made at the rate of eight mills per ton per mile for the difference between the weight of the stone transported and the finished weight, as laid in the piers. Any stone transmitted free, and not used, will be the property of the Railroad Company.

The Railroad Company will furnish cement for mortar, which must be handled from the cars, or storehouses by the Contractor, who will be held responsible for any loss or waste.

The Contractor will be required to furnish all tools of every description and all materials, except cement, and will be responsible for all damages which may occur from the conduct of the work embraced in his contract.

APPENDIX D.

RECORD OF SINKING CAISSONS. PIER I.

Date.	Elevations of Cutting Edge					Rate in 24 Hours	Elevations of Ground					Average Penetration of Caisson	Water Gauge.	Depth Immersed.	Weights.							Air Pressure.		Reaction due to Air Pressure	Net Weight	Surface in Contact	Average Weight per sq. ft. on surface exposed to friction.	Remarks
	N.E.	N.W.	S.E.	S.W.	Average.		N.E.	N.W.	S.E.	S.W.	Average				Caisson. Timber.	Caisson. Iron.	Caisson. Concrete.	Crib. Timber.	Crib. Iron.	Crib. Concrete.	Air Lock, Shaft, etc.	Masonry.	Sand.	Total.	Indicated.	Calculated.				
					C	D					E	F	G	H										I	K	L	M	N	O	P
						Ft.						Ft.	Ft.	Ft.	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Lbs.	Lbs.	L × A Tons	M Tons	Sq. ft.	N÷O Lbs.	
1886. Feb																														
18	844.17	844.38	844.37	844.46	844.39		—	—	—	—	—	—			155	25	—	—	—	—	6	—	—	186							Began Concreting at 8 a. m.
19	844.17	844.15	844.00	844.18	844.11	0.28									155	25	166	—	—	—	6	—	—	353							
20	844.02	844.06	843.86	844.12	844.00	0.81	847.00	847.00	847.00	847.00	847.00	3.00	848.35	4.35	155	25	392	3	—	—	6	—	—	583	4	1.88	179	904	360	1736	Started air pumps at 8.15 a. m. Started Water Pumps at 8 a. m.
21	844.21	844.47	844.17	844.44	844.33	0.15	851.49	849.04	851.02	850.91	850.61	8.70	848.35	4.02	155	25	578	6	—	—	6	—	—	773	2.75	2.65	284	1442	1647	940	Began building crib. Material passed through river sand.
22	837.64	837.56	838.25	837.42	837.72	3.61	851.50	851.80	850.29	851.12	851.18	13.57	848.00	10.90	155	25	578	21	1	209	7	—	24	1020	4.75	4.55	437	1968	1356	725	
23	834.35	834.37	834.53	834.65	834.47	1.83	851.70	851.70	850.40	851.07	851.07	17.70	849.30	14.85	155	25	578	36	2	417	8	—	38	1267	6	6.42	611	1653	760	996	
24	830.85	830.76	831.70	831.67	831.25	1.33	851.30	851.90	850.01	851.00	851.00	20.33	849.70	18.25	155	25	578	48	3	613	8	—	58	1480	7	7.36	760	1926	790	1092	
25	830.63	830.47	830.78	830.16	830.39	0.68	851.10	850.40	850.60	851.00	851.05	20.66	849.90	19.30	155	25	578	64	3	613	9	1	78	1526	8	8.42	884	2014	1113	1552	
26	828.26	828.17	828.30	828.00	828.18	1.96	851.10	850.70	850.60	851.00	851.08	22.40	850.05	21.42	155	25	578	92	3	774	9	1	93	1637	9	9.48	993	733	3443	1435	
27	825.03	824.87	824.45	824.40	824.69	3.44	851.40	851.90	850.90	851.00	851.05	24.64	850.20	25.15	155	25	578	132	4	955	9	—	101	1796	10	11.04	1057	843	4000	1400	
28	825.03	824.85	824.46	824.40	824.69	0.00	850.40	851.40	850.50	851.00	850.83	28.43	850.35	28.66	155	25	578	156	6	1148	9	1	130	1890	10.4	11.10	1057	833	4000	1400	
Mar.																														
1	824.49	824.33	824.40	824.36	824.39	0.30	851.70	851.00	850.00	851.00	850.93	26.68	850.60	26.41	155	25	578	192	6	1407	9	—	163	2033	11	11.44	1084	1876	4430	1417	
2	823.37	823.30	823.38	823.58	823.41	1.64	851.80	851.10	851.70	851.40	851.50	28.20	850.60	27.91	155	25	578	205	6	1504	10	—	196	2334	13	13.52	1149	1944	4900	1429	
3	814.69	814.69	814.69	814.70	814.69	8.67	851.10	851.00	851.70	851.00	851.20	36.70	850.85	36.35	155	25	578	270	7	1857	10	—	230	2740	15	14.89	1416	1964	5177	1465	
4	810.46	810.57	810.72	809.89	810.16	4.32	848.50	847.40	849.00	848.70	848.15	38.32	848.70	38.32	155	25	578	321	7	1530	11	—	256	2604	17	16.17	1586	1206	5714	1382	
5	808.63	808.53	807.43	807.65	808.14	2.02	846.90	846.40	846.50	850.63	848.61	40.46	848.25	40.11	155	25	578	338	8	1680	11	—	290	2888	17.5	17.33	1663	1233	5985	1178	
6	808.53	808.68	805.28	805.52	806.00	2.14	843.70	843.50	844.00	845.00	843.55	42.60	847.70	42.70	155	25	578	360	9	1602	12	—	326	3047	19.5	18.02	1716	1372	7022	978	
7	806.47	806.65	805.27	805.40	805.95	0.05	843.70	843.50	843.40	845.00	843.90	42.65	847.40	41.45	155	25	578	374	10	1733	12	—	430	3160	19.5	17.92	1707	1402	7053	897	
8	804.81	805.01	803.46	803.70	804.25	1.70	843.50	843.40	844.00	845.00	843.98	44.35	846.05	42.05	155	25	578	404	10	1735	13	—	466	3403	19	17.88	1770	1317	7238	818	
9	804.81	805.00	803.46	803.70	804.25	0.00	843.80	843.80	844.20	845.00	844.20	44.50	846.05	41.70	155	25	578	404	10	1735	13	—	466	3145	19.5	18.47	1789	1186	7238	818	
10	804.74	804.60	803.45	803.70	804.12	0.13	843.80	843.80	844.00	844.07	843.92	44.57	846.05	42.22	155	25	578	404	10	1735	13	—	466	3148	19	18.17	1740	1206	7313	793	
11	804.74	804.58	803.45	803.70	804.23	0.00	843.57	844.07	845.01	844.87	844.45	44.57	846.25	42.42	155	25	578	404	10	1735	12	—	466	3148	18.5	18.16	1732	1214	7335	786	
12	803.31	803.28	802.98	802.79	803.09	1.14	843.30	843.80	843.60	843.00	843.43	45.71	846.20	43.21	155	25	578	404	10	1808	12	—	473	3216	19	18.78	1786	1230	7578	784	
13	803.17	803.16	802.07	802.28	802.77	0.32	842.30	842.30	842.40	843.00	842.50	46.03	845.65	43.18	155	25	578	485	11	2053	13	—	473	3483	19	18.68	1777	1274	7396	963	
14	800.42	801.07	799.50	800.15	800.29	2.25	850.40	851.80	851.40	851.30	851.23	48.28	843.80	43.38	155	25	578	485	11	2323	13	—	485	3780	20	19.32	1906	1314	7720	981	
15	798.54	798.60	798.16	798.27	798.39	1.13	843.00	843.60	843.60	843.00	843.30	49.41	842.60	43.01	155	25	578	485	11	2327	13	—	741	3890	20.5	20.42	1937	1353	7853	994	
16	796.90	796.00	795.87	795.85	796.16	2.54	841.90	842.00	841.00	842.40	841.82	51.95	841.40	43.35	155	25	578	485	11	2620	13	—	575	4176	22	21.83	2034	1389	8149	1026	
17	793.60	793.51	793.58	793.50	793.54	3.29	850.00	850.40	850.00	852.20	850.65	55.24	841.40	43.74	155	25	578	485	11	2620	13	—	598	4204	23	22.43	2088	1427	8327	1001	Sand.
18	792.31	792.08	792.13	791.98	792.13	1.41	850.50	852.00	851.00	853.00	852.12	56.65	841.60	45.53	155	25	578	531	13	2610	15	—	638	4265	23.1	24.00	2236	1499	8676	1000	Reached clay.
19	792.02	791.78	791.85	791.70	791.84	0.28	851.40	852.60	852.00	852.00	852.00	56.93	838.70	46.83	155	25	578	531	13	2671	15	—	665	4354	24	24.02	2343	1502	8749	1000	
20	791.40	791.12	791.23	791.07	791.20	0.64	850.60	851.70	852.00	852.00	851.92	57.57	840.70	47.50	155	25	578	531	13	2835	14	—	684	4515	25	25.53	2491	1500	8770	1030	
21	791.41	791.13	791.24	791.10	791.22	0.02	851.00	851.80	852.00	851.80	851.90	57.59	840.70	47.52	155	25	578	531	13	2835	14	—	684	4515	25	25.50	2487	1500	8747	1030	
22	791.40	791.11	791.22	791.04	791.19	0.01	851.00	851.30	852.60	851.30	851.95	57.60	840.70	47.51	155	25	578	531	13	2835	20	—	684	4520	25	25.41	2478	1500	8775	1030	
23	791.40	791.14	791.22	791.04	791.20	0.00	850.00	851.70	852.00	852.20	851.98	57.60	841.00	47.60	155	25	578	531	13	2835	20	—	684	4533	25	26.01	2538	1502	8875	1034	
24	791.39	791.12	791.18	791.08	791.19	0.01	851.00	851.60	852.00	852.00	851.90	57.61	841.00	47.61	155	25	578	531	13	2835	20	—	684	4546	25	26.09	2546	1505	8903	1034	
25	791.37	791.04	791.19	791.09	791.10	0.01	851.00	852.00	852.00	852.00	852.00	57.62	841.00	47.62	155	25	578	531	13	2835	20	—	684	4549	25	26.11	2547	1502	8911	1034	
26	790.86	790.55	790.76	790.67	790.69	0.47	852.00	852.00	852.00	852.00	852.00	58.09	841.00	47.09	155	25	578	534	13	2836	20	—	686	4565	25	26.27	2564	1505	8970	1033	
27	788.84	788.54	788.76	788.57	788.68	2.01	853.00	853.00	856.00	855.00	854.25	60.10	841.00	47.10	155	25	578	534	13	2835	20	—	686	4580	25.5	26.63	2597	1514	9130	1030	
28	788.84	788.52	788.76	788.57	788.68	0.00	855.00	856.60	854.80	855.00	855.35	60.10	840.60	47.30	155	25	578	534	13	2835	20	—	686	4595	25.5	26.55	2587	1514	9085	1030	
29	788.53	788.20	788.48	788.24	788.36	0.32	854.00	855.70	853.80	854.00	854.35	60.42	840.00	48.02	155	25	578	534	13	2835	20	—	835	4705	25.5	27.40	2740	1514	9435	997	
30	787.84	787.51	787.77	787.55	787.67	0.69	854.00	855.00	853.70	855.00	854.29	60.80	840.00	47.80	155	25	578	534	13	2835	20	*50	865	4775	25	26.75	2756	2227	9537	866	
31	787.83	787.51	787.77	787.54	787.66	0.01	854.30	854.40	854.10	854.70	854.25	60.81	840.00	47.81	155	25	578	534	13	2835	20	50	833	4743	25	26.49	2573	2210	9403	1030	
Apr. 1	787.83	787.55	787.74	787.50	787.66	0.00	853.30	854.40	853.10	853.20	853.25	60.81	838.50	60.84	155	25	578	234	13	2835	20	50	833	4743	25	26.32	2507	1236	9403	1275	H=75.4 ft., L = 32.62 lbs., M = 3107 tons, N = 1636 tons, P = 348 lbs.
2	787.82	787.55	787.74	787.50	787.60	0.00	852.30	854.40	853.10	853.20	853.25	60.81	838.50	60.54	155	25	578	234	13	2835	20	50	833	4743	34	26.32	2507	1236	9403	1278	Test pit reached gravel. H = 80.8 ft., L = 34.96 lbs., M = 3330 tons, N = 1413 tons, P = 82.3 ft., L = 35.61 lbs., M = 3392 tons, N = 1355 tons, P = 288 lbs., [= 300 lbs
3	787.85	787.51	787.76	787.53	787.66	0.00	852.70	854.60	853.20	853.10	853.40	60.81	837.80	60.15	155	25	578	234	13	2835	20	50	833	4747	36	26.02	2478	1261	9423	1275	
4	787.14	786.81	787.05	786.80	786.95	0.71	851.30	853.80	852.50	852.50	852.52	61.52	837.60	60.63	155	25	578	234	13	2835	20	50	833	4745	26	25.12	2370	1261	9413	1275	
5	786.15	785.82	786.04	785.80	785.95	1.00	852.20	853.80	852.70	851.80	852.50	62.52	837.50	62.25	155	25	578	234	13	2835	20	50	833	4772	25	26.43	2515	1307	9528	1263	
6	786.15	785.82	786.04	785.80	785.95	0.00	852.20	853.80	852.70	851.80	852.50	62.52	837.35	62.40	155	25	578	234	13	2835	15	—	847	4717	25	27.13	2584	2113	9370	1255	Began sealing Caisson at 9.45 p. m.
7	786.04	785.76	785.97	785.72	785.88	0.00	854.10	854.30	852.40	851.70	853.12	62.64	836.50	62.92	155	25	578	234	13	2835	15	—	884	4739	25	27.22	2595	2147	9468	1248	
8	786.04	785.76	785.97	785.72	785.88	0.00	854.10	854.30	852.40	851.70	853.12	62.64	836.55	62.69	155	25	578	234	13	2835	15	—	884	4739	24	27.11	2585	2137	9468	1248	
9	786.03	785.76	785.97	785.72	785.88	0.00	853.80	853.90	852.30	852.20	852.80	63.44	836.00	63.44	—	—	—	—	—	—	—	—	—	—	26	26.96	—	—	—	—	Finished filling working chamber at 5 a. m Took air off at 2:15 p. m.

*Rabble Stone Piled on Crib

RECORD OF SINKING CAISSONS. PIER II.

Date	Elevations of Cutting Edge N E	N W	S E	S W	Average	Sunk in 24 Hours	Elevations of Ground N E	N W	S E	S W	Average of 12 Soundings	Average Penetration of Caisson	Water Gauge	Depth Immersed
1887					C	D					F	F E C	G	H G—C
Feb						Ft						Ft		Ft
10	850.88	850.88	850.88	850.88	850.88		—	—	—	—			846 30	
11	843.32	843 32	843 32	843 32	843 32	7 56	—	—	—	—			846.40	3 08
12	838 65	838 65	838 65	838 65	838 65	4 67	—	—	—	—			846 45	7 80
13	837.79	837.79	837 79	837 79	837.79	0 86	—	—	—	—			846 45	8 66
14	837 15	837 15	837 15	837.15	837 15	0 64	—	—	—	—			846 30	9 15
15	837 13	837 13	837 13	837.13	837 13	0 02	—	—	—	—			846 35	[illegible]
16	[illegible]	836 23	836.04	835.98	836 14	0 99	[illegible]	837.40	838.70	[illegible]	838 99	2.85	846 45	[illegible] 31
17	829 86	830 25	829.91	830 37	830 08	6 06	846 20	843 40	[illegible]	[illegible]	[illegible]	11 [illegible]	846 41	16 37
18	829 65	[illegible] 22	[illegible]	830 30	830.06	0 02	845 70	843 75	[illegible]	[illegible] 20	842	[illegible]	846 [illegible]	16 69
19	829.84	830 37	829 86	830 3	830.06	0 00	[illegible]	844 00	[illegible] 60	[illegible] 80	[illegible]	1 96	84[illegible] 00	16 [illegible]
20	[illegible]	830 20	[illegible]	830.27	[illegible]	0 03	844 50	843.30	[illegible] 40	842 30	841 7[illegible]	[illegible]	84[illegible] 30	17.27
21	829.77	830 00	829 79	830 09	829.93	0 10	[illegible]	841.60	[illegible] 40	841.60	841. 56	11 63	[illegible]	17 6[illegible]
22	824 17	[illegible]	824 32	824 53	[illegible]	5 59	848 20	[illegible] 40	847 50	[illegible]	846 04	[illegible]	[illegible]	23 3[illegible]
23	820.55	[illegible] 45	820.37	820 37	820 43	3 [illegible]	847.80	[illegible]	847 40	845 70	[illegible]	26 39	847 65	[illegible]
24	820.54	820 46	820.36	820 3	820 4	0 01	847.00	847.20	847 00	[illegible]	[illegible]	[illegible]	[illegible] 65	27 [illegible]3
25							847.00	846 80	[illegible]	846 40	846 19		[illegible]	
26							846 80	846 00	[illegible]	[illegible] 60	[illegible]		[illegible]	
27	[illegible]	820 46	820.35	820 30	[illegible]		[illegible]	845 60	[illegible]	848 00	[illegible]	25.67	[illegible] 45	[illegible] 04
28							847 30	843 80	847.30	847.30	845.75		847.30	
Mar														
1							846.00	846 20	847 20	[illegible]	[illegible]		[illegible] 75	
2	[illegible]	[illegible]	820 35	820.29	[illegible]	[illegible]	[illegible]	846 20	[illegible]	846 20	[illegible] 90	[illegible]	[illegible]	26 [illegible]
3	820.52	[illegible]	820 33	820 28	[illegible]	[illegible] 02	846.50	[illegible]	846.60	[illegible]	[illegible]	[illegible]	[illegible]	26.96
4	[illegible] 50	820 43	[illegible]	[illegible]	[illegible]	[illegible] 01	847.10	[illegible] 60	846 70	[illegible]	[illegible]	[illegible]	[illegible] 60	[illegible]
5	820 48	[illegible]	820.28	820.24	[illegible]	0 03	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	847 55	[illegible]
6	820.48	[illegible] 40	820 28	820.24	820 35	0 00	844.00	[illegible]	[illegible]	847 40	[illegible]	[illegible] 04	[illegible]	[illegible].05
7							845.00	[illegible]	[illegible]	847 00	[illegible]		847 00	
8													846 90	
9											—		845.90	
10												—	847.00	
11	[illegible]	[illegible] 35	[illegible]	820.31	[illegible]	0 04				—			[illegible] 15	[illegible]
12							838.72	838.20	[illegible]	843.70	840 32		[illegible]	
13													849 00	
14							[illegible]	[illegible]	836.50	[illegible]	[illegible]		850 50	
15							[illegible]	820 50	837 50	[illegible]	[illegible]		850 45	
16													850 45	—
17							[illegible]	821 70	[illegible]	[illegible]	[illegible]		[illegible] 20	
18	820 30	[illegible]	820 21	[illegible] 13	820 22	[illegible] 09	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	850 60	30 3[illegible]
19	[illegible]	817	[illegible]	817.33	[illegible]	3 20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	851.15	34.13
20	815.38	815 [illegible]	815.04	[illegible]	815.51	51	[illegible]	[illegible]	[illegible]	837 20	[illegible]	[illegible]	850 20	34.69
21	[illegible]	[illegible]	[illegible]	[illegible]	813 86	65	[illegible]	829 40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	35 59
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] 73	[illegible]	828 40	834.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible] 23	[illegible]	[illegible]	[illegible]	[illegible] 93	[illegible]	827.40	833 90	839.40	834.70	25 50	849.40	40.20
24	[illegible]	808 90	808.38	[illegible]	[illegible]	0 55	826.90	[illegible]	832.90	[illegible]	830.82	22 17	848 95	40.30
25	[illegible]	[illegible] 50	[illegible]	807.05	806.74	[illegible]	828.30	824 80	832.80	[illegible]	830 97	24 23	[illegible]	42.06
26	[illegible]	[illegible] 60	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	829.20	830 97	[illegible] 00	852.20	[illegible]
27	[illegible]	[illegible] 55	[illegible]	804.59	804.61	1 36							854 00	49 39
28	804.58	[illegible]	[illegible]	[illegible]	804.32	[illegible]		814 80		[illegible]	816 80	12.48	[illegible]	[illegible]
29	804 59	[illegible]	[illegible]	804.05	804.32	[illegible]					820 90	[illegible]	[illegible] 30	[illegible]
30	[illegible] 55	804 29	[illegible]	[illegible]	804.28	[illegible]	[illegible]	819 60	819.60	819.60	820 85	16.57	[illegible]	[illegible] 37
31	[illegible]	[illegible] 29	804.25	[illegible]	[illegible]	[illegible]	819.30	[illegible] 30	819.30	821.30	821.05	16.77	855 30	51 02
Apr														
1	804.54	804.28	[illegible]	804.01	[illegible]	01	[illegible] 30	816.30	818 30	[illegible] 30	[illegible]	[illegible]	[illegible] 30	[illegible] 03
2	[illegible]	[illegible] 13	[illegible]	[illegible]	804 10	0 17	820.40	[illegible]	[illegible] 40	[illegible]	819 74	15 64	[illegible]	[illegible]
3	[illegible]	[illegible]	803.94	[illegible]	[illegible]	[illegible]	823 50	[illegible]	[illegible]	825.50	822.33	18.31	852 50	[illegible]
4	[illegible]	803.78	802.79	[illegible]	803.30	72	825.70	821 70	822.70	825.70	[illegible]	[illegible]	[illegible] 75	48.45
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30	[illegible]	825.90	[illegible]	[illegible]	[illegible]	[illegible]	850.90	[illegible]
6	800.35	[illegible]	[illegible]	799.70	[illegible]	[illegible]	825.10	824.10	[illegible]	825.10	[illegible]	22.98	851.15	51
7	[illegible]	[illegible]	[illegible]	799.42	799.47	[illegible]	825.50	[illegible]	[illegible]	828 00	[illegible]	[illegible] 16	[illegible]	[illegible] 03
8	[illegible]	797 93	[illegible]	798.72	798 27	[illegible]	[illegible]	826 40	[illegible]	[illegible]	826.32	28.05	[illegible]	[illegible]
9	794 87	794 97	795.17	[illegible]	[illegible]	[illegible]	826 50	[illegible]	825 00	828 50	[illegible]	[illegible]	[illegible]	54 43
10	792.45	792.76	792.55	[illegible]	[illegible]	2 41	[illegible]	830.00	[illegible]	833.50	[illegible]	[illegible]	849.05	[illegible]
11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	38.72	[illegible]	57.55
12	791.35	791.46	791 21	791.32	791.34	0 01							848.60	57.26
13	791 34	791 44	791.21	791 34	791 33	[illegible]							848.60	[illegible]
14	791 33	[illegible]	[illegible]	791.34	791.33	0 00							[illegible]	57 47
15	791 34	791 43	791.18	791 33	791.32	[illegible]							[illegible] 15	[illegible]
16					—								[illegible]	

Date	Weights: Caisson Timber	Caisson Iron	Caisson Concrete	Crib Timber	Crib Iron	Crib Concrete	Air Lock Shaft etc.	Masonry	Sand	Water	Total	Air Pressures Indicated	Air Pressures Calculated	Reaction of Air Pressure	Net Weight	Surface in Contact	Average Weight per sq ft on surface exposed to friction	Remarks
1887											I	K	L	M L×A	N I—M	O	P N÷O	
Feb	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Lbs	Lbs	Tons	Tons	Sq Ft	Lbs	
10	177	32					7	-	—		216	—	—	—	—			Caisson built at elev. 850.88. Began lowering at 8.30 a. m.
11	177	32	·	—			7		—	—	216	—	—	—	—	—	—	Began concreting at 12.40 p. m Stopped at 3 30 p. m.
12	177	32		—			7		—	—	216	—	—	—	—	—	—	
13	[illegible]	32	[illegible]				7		—	—	[illegible]	—	—	—	—	—	—	
14	[illegible]	32	[illegible]				7		—	—	513	—	—	—	—	—	—	
15	177	32	515				7		—	—	731	—	—	—	—	—	—	Put on air at 6:45 p m. Started water pumps at 8.45 a. m.
16	177	32	715				7		—	7	[illegible]	5	[illegible]	[illegible]	[illegible]	[illegible]	2054	
17	177	32	764				7	—			[illegible]							Began building crib in P. M. Stopped water pumps 4:10 a m. Resumed work in Pier III at [illegible] m., 17th.
18	177	32	[illegible]	[illegible]			8				[illegible]							
19	177	32	856	38	1	53	8				[illegible]							
20	177	32	856	43	2	168	8				1286							
21	177	32	[illegible]	[illegible]	3	[illegible]	9		16	[illegible]	[illegible]	[illegible]	[illegible] 64	[illegible]	[illegible]	861	733	Resumed work in Pier II at 6:45 a. m. Started water pumps at 6:55 a. m.,
22	[illegible]	[illegible]	856	55	3	490	[illegible]		[illegible]	30	[illegible]		10.08	[illegible]	688	[illegible]	[illegible]	[illegible]
23	177	[illegible]	856	55	3	690	9	—					—					Stopped water pumps at 5 a. m. Resumed work in Pier III at 6.45 a m.
24	177	32	856	55	3	[illegible]	9	—					—		—			Working in Pier III.
25	177	32	856	[illegible]	4	[illegible]	9											
26	177	32	856	[illegible]	[illegible]	[illegible]	9											" " "
27	177	32	856	92	6	[illegible]	9											"
28	[illegible]	32	856	92	[illegible]	[illegible]	9											
Mar																		
1	[illegible]	32	856	[illegible]	6	[illegible]	9											All work suspended—ice too weak.
2	[illegible]	32	[illegible]	92	[illegible]	[illegible]	[illegible]											" " "
3	[illegible]	32	856	[illegible]	6	1033												" "
4	177	32	[illegible]	[illegible]	[illegible]	[illegible]												"
5	177	32	856	[illegible]	6	[illegible]	9											
6	[illegible]	32	[illegible]	[illegible]	7	1346	9											"
7	[illegible]	32	[illegible]	116	7	[illegible]	[illegible]											" "
8	[illegible]	32	[illegible]	116	[illegible]	1346	[illegible]											Ice went out at 5 p. m.
9	177	32	856	[illegible]	7	1346	[illegible]											
10	[illegible]	[illegible]	[illegible]	[illegible]	7	[illegible]	[illegible]											
11	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]											[illegible] III at [illegible] 30 [illegible]
12	177	32	856	116	7	[illegible]	[illegible]											Working in Pier III.
13	[illegible]	[illegible]	[illegible]	116	7	[illegible]	[illegible]											" " "
14	[illegible]	[illegible]	856	116	7	[illegible]	[illegible]											" "
15	[illegible]	[illegible]	856	116	7	1346	9											
16	177	[illegible]	[illegible]	[illegible]	7	[illegible]	9											" " "
17	[illegible]	[illegible]	856	116	[illegible]	[illegible]	[illegible]											
18	177	[illegible]	[illegible]	116	[illegible]	[illegible]	[illegible]											[illegible]
19	177	32	856	[illegible]	7	1346	[illegible]		20	178	2741	15	14.76	[illegible]	1165	1960	[illegible]	Sand. Pumps stopped at 10:30 p. m
20	[illegible]	32	856	[illegible]	7	[illegible]	[illegible]		26	[illegible]	[illegible]	7	15.00	[illegible]	[illegible]	[illegible]	1123	Pumps started at 7.10 a. m and stopped at 3 15 p. m
21	177	[illegible]	856	[illegible]	8	[illegible]	[illegible]		[illegible]	[illegible]	3001	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	" 8.25 a. m. " 2:45 p. m
22	[illegible]	[illegible]	856	135	[illegible]	[illegible]	[illegible]		116	[illegible]	[illegible]	[illegible]	[illegible]	1767	[illegible]	[illegible]	[illegible]	" [illegible] " [illegible]
23	177	32	856	145	9	1855	[illegible]		172	[illegible]	3420	[illegible]	17.39	[illegible]	1563	[illegible]	801	" 7 00 a. m. " 2 35 p. m
24	177	[illegible]	856	[illegible]	[illegible]	1983	12	—	116	[illegible]	3535	[illegible]	17.43	[illegible]	1674	3458	968	" 7 10 a. m. " 6:35 p m
25	[illegible]	[illegible]	856	[illegible]	[illegible]	2106	13	—	[illegible]	[illegible]	[illegible]	20	18 19	[illegible]	[illegible]	[illegible]	[illegible]	" 6:55 a. m " 6:35 p m
26	[illegible]	32	[illegible]	[illegible]	[illegible]	[illegible]	13		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1752	[illegible]	[illegible]	" 8:35 a. m " 12:40 p. m. Current too swift for soundings.
27	177	32	856	[illegible]	11	2217	13		70	[illegible]	3843	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1510	Current too swift for soundings. Pressure men and others working on bar saving [material, track, etc. from flood
28	[illegible]	[illegible]	856	[illegible]	11	[illegible]	13	—	[illegible]	[illegible]	[illegible]	[illegible]	21.81	[illegible]	1560	[illegible]	[illegible]	" " "
29	[illegible]	32	[illegible]	178		[illegible]	13		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	"
30	177	[illegible]	856	[illegible]	11	[illegible]	13		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15	[illegible]	[illegible]	
31	177	[illegible]	856	178	11	2217	[illegible]		[illegible]	381	3903	22	[illegible]	2357	1546	2678	1155	
Apr																		
1	[illegible]	[illegible]	[illegible]	[illegible]	11	[illegible]	[illegible]		[illegible]	[illegible]	3887	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
2	[illegible]	32	856	[illegible]	11	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
3	177	32	[illegible]	178	[illegible]	[illegible]	[illegible]		[illegible]	337	4074	[illegible]	20.97	[illegible]	1835	[illegible]	1257	Pumps started at 7:20 a. m. Sand, gravel and balls of clay
4	[illegible]	[illegible]	856	178	11	[illegible]	[illegible]	—	77	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2500	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2500	[illegible]		[illegible]	333	[illegible]	23	22	2361	[illegible]	[illegible]	[illegible]	Finished crib. Pumps stopped at 6:40 p m and started at 10.50 p m
7	[illegible]	[illegible]	[illegible]	[illegible]	13	[illegible]	[illegible]	·	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Pumps stopped at 9:20 p. m.
8	177	[illegible]	856	[illegible]	[illegible]	2775	[illegible]		216	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Caisson on clay in north end. Started at 12 45 p m.
9	177	[illegible]	[illegible]	[illegible]	13	2810	[illegible]		276	300	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	925	Finished concreting crib.
10	[illegible]	[illegible]	856	[illegible]	13	2810	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Pumps stopped at 9:25 a. m.
11	[illegible]	[illegible]	856	[illegible]	13	[illegible]	4		[illegible]	259	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	749	Pumps started at 8:25 a m. and finished at 5 [illegible] p m [illegible]
12	[illegible]	32	856	198	13	2810	[illegible]			—								Cut off air at 6.55 a. m. and resumed work in Pier III.
13	177	[illegible]	856	[illegible]	13	2810	14	71										Working in Pier III.
14	[illegible]	32	856	[illegible]	13	2810	14	234										" "
15	77	32	[illegible]	198	13	[illegible]	15	333										"
16	177	32	[illegible]	198	13	[illegible]	15	[illegible]				—	—					" "

APPENDIX D. – Continued.

PIER II. CONTINUED.

Date	Elevations of Cutting Edge: N E	N W	S E	S W	Average	Sinking Hours	Elevations of Ground: N E	N W	S E	S W	Average of 12 Soundings	Average Depth of Excavation (Cubic Contents)	Weight of Cutting Edge	Depth Sunk	Weights: Caissons: Timber	Caissons: Iron	Caissons: Concrete	Cribs: Timber	Cribs: Iron	Cribs: Concrete	Air Locks: No.	Masonry	Sand	Water	Total	Number of Passengers: Indicated	Number of Passengers: Calculated	Resistance per sq. ft. of Surface Pressure	Net Weight	Surface in Contact	Average Weight per sq. ft. of Surface Exposed to Friction	Remarks
1887 Apr.																															
17	791.30	791.43	791.19	791.30	791.31	0 01								850.10	38.79	177	32	856	196	13	386.0	15	580				—					Working on Pier III.
18														850.20		77	32	856	198	3	28.0	2	280									" "
19														849.85		77	32	856	198	13	28.0	15	540				—					" "
20							843.0	845.10	847.10	846.10	845.02			849.70		177	32	856	198	13	28.0	13	540									" "
21							848.70	851.70	850.70	847.70	849.70			849.60		177	32	856	198	13	28.0	15	540				—					" "
22														849.30		77	32	856	198	13	28.0	15	540									" "
23	791.33	791.42	791.22	791.32	791.32									849.10	37.70	177	32	856	198	13	28.0	15	540									" "
24														848.90		77	32	856	198	13	28.0	15	540									" "
25														848.65		177	32	856	198	13	28.0	15	540									" "
26														848.35		77	32	856	198	13	28.0	15	540									" "
27	791.30	791.41	791.14	791.26	791.28	0 03								848.45	37.17	177	32	856	198	13	28.0	15	540									Put on air at 7.00 p. m.
28	791.27	791.40	791.13	791.23	791.26	0 07	829.10	827.10	829.10	833.10	832.05	38.05		848.15	36.89	177	32	856	198	13	28.0	23	540	113	75	1327	26	24.73	3628	2644	3631	956	Set up clay hoist and began working it at 6 p. m
29	791.23	791.36	791.06	791.15	791.24	0 02	829.10	827.10	829.60	833.10	830.60	35.36		848.10	36.86	177	32	856	198	13	28.0	22	540	442	246	1330	25 5	24.59	3626	2644	3642	954	Clay
30	790.04	790.15	789.86	790.05	790.02	1 09	833.50	831.50	829.50	833.50	832.15	42.10		847.90	37.84	177	32	856	198	13	28.0	22	540	504	297	1341	26 5	25.02	3678	2643	3700	961	"
May																															
1	789.45	789.62	789.40	789.53	789.51	0 54	836.60	833.60	833.60	833.60	833.60	43.71		847.60	38.08	177	32	856	198	3	28.0	22	540	336	206	1340	27	25.13	3683	2707	63	857	
2	789.42	789.59	789.38	789.48	789.48	0 10	838.50	835.50	835.00	833.50	833.50	44.09		847.50	38.09	177	32	856	198	13	28.0	22	540	534	298	1340	26	25.13	3683	2713	6336	853	
3	788.56	788.78	787.94	788.07	788.34	1 30	838.50	835.50	835.50	833.50	834.00	45.86		847.55	39.44	177	32	856	198	13	28.0	22	540	540	298	1340	27	25.71	3745	2690	6495	816	
4	787.71	787.89	787.54	787.57	787.67	0 44	838.50	835.50	835.40	833.50	834.44	46.27		847.40	39.73	177	32	856	198	13	28.0	22	540	612	342	1430	26	25.84	3761	2687	6707	802	
5	787.53	787.74	787.31	787.48	787.50	0	838.50	835.50	835.50	833.50	834.50	46.20		847.30	39.70	177	32	856	198	13	28.0	22	540	618	361	1459	26	25.84	3761	2687	6707	796	Clay hoist broke down at 5 a. m. Stuck in shaft
6	787.70	787.98	787.48	787.51	787.36	0 4	838.50	836.00	835.40	833.70	835.15	47.79		847.10	39.74	177	32	856	198	3	28.0	22	540	636	377	1461	26 5	25.84	2759	2707	6834	791	
7	786.30	786.57	786.29	786.41	786.44	0 25	838.50	836.03	838.25	832.30	834.61	48.17		847.05	40.01	177	32	856	198	13	28.0	22	540	654	386	1480	26 5	26.32	2800	2683	6885	759	
8	786.03	786.10	785.85	785.96	785.98	0	838.50	836.00	838.10	832.10	834.40	48.20		847.00	40.12	177	32	856	198	13	28.0	22	540	654	390	1484	27	26.44	2813	2683	6913	760	Clay hoist started up at 10.40 a. m.
9	785.67	785.76	785.51	785.60	785.63	0 33	838.50	836.00	838.50	834.70	835.87	50.14		846.70	40.56	177	32	856	198	3	28.0	22	540	693	402	1535	24	26.03	2844	2681	7137	751	
10	785.62	785.72	785.45	785.58	785.59	0 34	838.50	836.50	841.50	832.80	835.80	50.03		846.70	40.71	177	32	856	198	13	28.0	22	540	696	407	1543	25 5	26.09	2852	2677	7158	749	
11	784.11	784.15	784.02	784.38	784.08	1 13	838.50	836.50	841.50	833.70	837.50	51.17		846.50	40.98	177	32	856	198	13	28.0	22	540	738	423	1582	27 5	27.31	2971	2668	7365	774	
12	783.65	783.70	783.71	783.78	783.61	0 25	838.50	836.50	838.50	834.00	836.38	52.03		846.50	41.03	177	32	856	198	13	28.0	22	540	750	431	1601	25	27.55	3432	2668	7351	771	
13	783.73	783.80	783.59	783.76	783.70	0	838.50	836.50	841.50	834.50	837.50	53.17		846.50	41.04	177	32	856	198	13	28.0	22	540	771	442	1624	28	27.77	3463	2668	7376	767	
14	783.33	783.38	783.14	783.21	783.26	0 04	838.50	836.50	841.50	834.80	837.33	53.30		846.50	41.04	177	32	856	198	3	28.0	22	540	780	454	1642	28 5	27.97	2981	2661	7931	697	
15	781.69	781.74	781.50	781.54	781.57	1 04	838.50	836.50	841.50	833.70	837.50	53.71		846.30	41.08	177	32	856	198	13	28.0	22	540	786	457	1683	28 5	28.03	3047	2657	7954	692	
16	781.54	781.58	781.45	781.50	781.52	0 05	838.50	836.50	841.50	833.70	837.50	53.66		846.25	41.06	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.65	3053	2656	7958	692	
17	781.53	781.56	781.46	781.48	781.51	0 0	838.50	836.50	841.50	833.70	837.35	53.84		846.20	41.06	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
18	779.72	779.76	779.68	779.73	779.72	1	838.50	836.50	841.50	834.50	837.50	53.47		846.10	41.04	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
19	779.41	779.42	779.38	779.40	779.40	0 32	838.50	836.50	841.50	835.25	837.25	53.08		846.00	41.03	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
20	779.30	779.29	779.24	779.26	779.27	0 13	838.50	836.50	841.50	835.10	837.10	53.83		845.90	41.02	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
21	779.05	779.08	778.98	779.03	779.04	0 23	838.50	836.50	841.50	835.70	837.50	53.61		845.80	41.01	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
22	778.57	778.56	778.52	778.51	778.54	0	838.50	836.50	841.50	835.70	837.50	53.38		845.70	41.00	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
23	776.89	776.72	776.70	776.70	776.70	0 04	838.50	836.50	841.50	834.25	837.25	53.25		845.60	40.98	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
24	776.61	776.56	776.58	776.58	776.59	0	838.50	836.50	841.50	835.25	837.25	53.47		845.50	40.99	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
25	776.64	776.64	776.58	776.58	776.58	0	838.50	836.50	841.50	835.25	837.25	53.33		845.40	40.97	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
26	776.64	776.64	776.58	776.58	776.58	0	838.50	836.50	841.50	835.25	837.25	53.47		845.30	40.99	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
27	776.64	776.64	776.58	776.58	776.58	0	838.50	836.50	841.50	835.25	837.25	53.33		845.20	40.97	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
28	773.48	773.47	773.50	773.49	773.49	1 23	838.50	836.50	841.50	834.80	837.50	53.02		845.10	40.96	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
29	772.31	772.31	772.33	772.33	772.32	1 13	838.50	836.50	841.50	835.50	837.50	53.19		845.00	40.97	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
30	772.09	772.10	772.11	772.10	772.10	0 23	838.50	836.50	841.50	835.50	837.50	53.47		844.90	40.98	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
31	770.34	770.33	770.35	770.35	770.42	1 08	833.05	835.05	835.05	833.05	834.20	53.14		844.85	40.93	177	32	856	198	13	28.0	22	540	792	460	1687	28 5	28.03	3047	2656	7955	692	
June																															
1	769.33	769.33	769.33	769.46	769.41	0 31	832.20	833.20	835.20	835.20	834.20	53.81		848.30	39.84	177	32	856	196	3	28.0	22	540	1111	597	1725	32	33.05	3543	2429	8009	714	Stopped clay hoist from 2 p. m. to 4 p. m.
2	768.25	768.25	768.26	768.28	768.26	1 08	834.15	833.15	835.15	835.15	834.15	53.32		848.15	39.42	177	32	856	198	3	28.0	22	540	1101	583	1723	33	34.36	3609	2429	8885	703	
3	768.12	768.04	768.31	768.22	768.18	0 53	836.80	831.80	838.80	833.80	835.05	53.63		848.00	39.62	177	32	856	198	13	28.0	22	540	1101	583	1723	33 5	34.87	3723	2429	8875	700	Put on air at 7.00 p. m. Stopped clay hoist from 7.45 p. m. to 8.45 p. m.
4	767.80	767.76	767.95	767.86	767.84	0 34	831.60	832.60	837.00	834.60	833.68	54.03		849.15	39.55	181	32	846	198	3	28.0	23	567	1218	644	1929	33 5	35.17	3737	2454	9052	704	Stopped clay hoist from 7.40 p. m. to 10.20 p. m. Caisson at 767.72
5	766.64	766.59	766.75	766.71	766.68	0 16	831.00	832.00	835.00	833.00	832.08	54.30		849.05	39.50	177	32	856	198	13	28.0	23	1235	1313	748	2235	32	35.03	3805	2450	8969	722	
6	766.57	766.51	766.73	766.62	766.61	0 07	829.00	831.00	833.00	833.00	830.44	54.83		849.00	39.50	177	32	856	198	3	28.0	23	1235	1317	750	2236	32	35.77	3920	2450	8809	730	
7	766.10	766.05	766.27	766.16	766.14	0 17	830.40	831.40	836.00	834.40	832.78	55.04		848.95	39.45	183	31	846	198	3	28.0	23	1311	1255	749	2171	34	36.04	3843	2373	8968	730	
8	765.95	765.89	766.02	766.00	765.98	0 16					832.78	55.20		848.90	39.40	177	32	846	198	13	28.0	23	1311	1563	923	2308	34.5	36.36	3924	3304	9412	725	Stopped clay hoist from 4.40 p. m. to 6.30 p. m.
9	765.66	765.62	765.75	765.68	765.68	0 30						55.17		848.85	39.35	177	32	856	198	3	28.0	23	1311	1277	556	2733	36	37.10	3962	3304	9141	720	Finished using clay hoist at 1.45 p. m.
10	765.49	765.54	765.54	765.53	765.51	0 17					832.78	55.27		848.80	39.32	177	32	856	198	13	28.0	17	1311	987	569	2767	37.5	37.37	3990	3280	9161	725	Began filling working chamber.
11	765.47	765.42	765.58	765.51	765.49	0 02								852.60	38.31	177	32	856	198	13	28.0	17	1311				37.5	37.68	4023				
12														853.20		177	32	856	198	13	28.0	17	1335				36.						
13														854.00		177	32	856	198	13	28.0	17	1335				36.					Thermometer 100° in lock
14	765.47	765.42	765.58	765.49	765.49	0 00								854.00	38.03	177	32	856	198	13	28.0	17	1335				36.	38.33	4093				Gauges working 2 hours per day, account of heat
15														853.85		177	32	856	198	13	28.0	17	1335				34.5					
16														853.55		177	32	856	198	13	28.0	17	1335				32.					Pressure varying from 30 lbs. to 34 lbs.
17														853.15		177	32	856	198	13	28.0	17	1335				32.					" "
18														852.95		177	32	856	198	13	28.0	17	1335									Ran pressure down to 25 lbs at 5.40 p. m
19														853.15																		Took off air at 7.05 a. m.
20	765.44	765.39	765.55	765.49	765.47	0 02								853.55	38.08																	Final elevation of cutting edge 765.47.

RECORD OF SINKING CAISSONS. PIER III.

Date	Elevations of Cutting Edge N E	N W	S E	S W	Average C	Sunk in 24 Hours D	Elevations of Ground N E	N W	S E	S W	Average E	Average Height of Caisson E–C	Water Gauge G	Depth in Ground G C H	Weights Caisson Timber	Caisson Iron	Caisson Concrete	Crib Timber	Crib Iron	Crib Concrete	Air Locks, Shafts, etc.	Masonry	Sand	Water	Total I	Air Pressure Indicated. K	Air Pressure Calculated. L	Reaction due to Air Pressure M L×A	Net Weight I–M	Surface in Contact O	Average Weight per sq. ft. on Surface Exposed to Friction P
1886															Tons	Tons	Tons	Tons.	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Lbs	Lbs.	Tons	Tons	Sq Ft	Lbs
Nov						Ft.						Ft.																			
23	846.80	846.80	846.80	846.80	846.80								842.50		177	34					7				218						Caisson built at elev. 846.80
24	842.10	842.10	842.10	842.10	842.10	4 70	—		—				842.05		177	34					7				218	—					Began lowering caisson in P. M.
25	833.30	833.40	833.30	833.30	833.30	8 80							842.70	9.40	177	34	89	—	—	—	7			5	312						Began concreting in A. M
26	830.70	830.70	830.70	830.70	830.70	2 60							841.90	11.20	177	34	114				7			9	341						
27	828.80	827.30	829.80	829.80	829.42	0 88	—		—				841.80	12.38	177	34	114				7			11	343						
28		—			829.10	0 32		—		—			843.00	13.90	177	34	205	—			7		—	15	450						
29					829.10	0 00							843.50	13.90	177	34	134				7			15	467	—	—	—			
30	829.40	829.60	828.90	828.40	829.10	0 00	831.10	831.60	830.10	829.10	830.00	00.90	842.60	13.50	177	34	605				7			15	836			145			
Dec.																															
1	828.70	827.70	828.30	828.20	828.40	0 60	826.90	826.40	828.00	826.40	828.03	00.43	842.90	14.50	177	34	605				7			15	838			69			Began building crib.
2	828.30	827.60	828.20	828.10	828.05	0 08	828.90	827.10	828.90	828.30	828.05	00.05	842.90	14.58	177	34	605				7			15	838			86			
3					828.32	0 00	827.75	827.25	831.75	831.75	829.29	00.67	841.25	12.93	177	34	605	6			7			13	844	—	—	159			
4	827.90	827.30	829.70	827.90	827.75	0 57	828.10	824.70	829.70	827.76	827.96	00.13	842.70	13.93	177	34	605	16			7			15	853			24			Put on air at 10 a. m. 4 lbs. Started water pumps at 4 p. m
5	826.70	824.70	828.10	826.60	826.60	1 15	830.70	826.30	830.10	823.60	827.68	01.28	842.70	16.10	177	34	762	33			7			22	1024	5	6.96	733	291	1946	Pumps stopped at 9.35 p. m Sand
6	825.80	825.95	825.60	825.60	825.69	0 98	834.70	827.80	831.70	829.60	830.95	05.25	843.00	17.38	177	34	830	30	2	10		1	24	1115	6	7.51	803	313	676	1208	
7	825.35	825.55	825.10	825.30	825.40	0 22	834.10	827.30	829.40	829.10	829.71	04.31	843.75	18.35	177	34	830	30	2	300		1	24	1166	6	7.54	805	361	804	1737	
8	825.21	825.69	825.70	825.70	825.70	0 80	833.70	828.20	830.20	830.20	829.85	05.25	843.70	18.00	177	34	830	30	2	300		1	32	1215	7	9.04	859	356	846	1314	Pumps started at 6.55 a m
9	825.63	825.39	825.60	825.40	825.51	3 09	836.35	833.75	830.55	831.15	832.25	06.75	843.75	17.21	177	34	83	42	3	530	8		15	57	1196	9	7.60	1027	869	1796	744	Pumps stopped at 5.35 a. m
10	824.40	824.21	824.32	824.10	824.26	0 53	830.60	833.10	830.60	831.30	831.33	07.13	844.10	22.82	177	34	830	42	3	530			13	61	1707	7	9.87	1694	653	2347	1000	Cut off air from 1 p. m to 5 p. m. to change position of boat.
11	826.10	826.20	826.90	830.70	830.70	0 48	825.80	824.80	831.80	827.50	827.50	03.20	844.90	[illegible]	—	—	830	2	3	530	9		25	69	1734	6	10.32	1113	621	2676	600	
12	820.70	819.60	821.70	823.70	820.73	0 07	824.40	821.30	827.10	826.30	826.63	06.11	843.40	22.67	177	34	830	42	3	530	9		5	61	1704	6	9.80	1636	1068	4101	1314	Pumps started at 11 a. m
13	818.14	818.23	820.64	817.79	817.95	2 78	823.30	821.30	827.30	825.30	824.30	07.70	843.30	25.33	177	34	830	63	3	530	9		9	96	1916	9.5	10.56	1012	746	1900	1100	Pumps stopped at 11 p. m
14	815.56	815.59	815.69	815.69	815.63	2 33	827.40	819.50	825.60	824.60	826.61	10.98	843.70	27.87	—	34	830	84	3	767	9		15	111	2010	10.5	13.01	1388	778	2761	977	
15	815.56	815.52	815.61	815.61	815.61	0 00	827.10	821.00	828.16	822.10	824.59	08.98	843.40	28.46	177	34	830	90	3	767	9		15	118	2025	11.5	12.36	1316	709	2413	891	
16	815.30	815.59	815.63	815.58	815.52	0 09	822.80	822.80	822.80	832.60	827.80	03.30	843.80	28.28	177	34	830	98	3	767	9		15	103	2035	11.5	11.13	1307	730	2437	891	
17	815.53	815.58	815.63	815.63	815.60	0 02	823.50	821.80	831.60	833.00	827.73	04.23	843.80	28.05	177	34	830	86	6	1153	9		12	93	2116	11.5	12.19	1402	714	2612	897	
18	815.00	815.06	815.17	815.16	815.10	0 45	823.70	822.70	831.81	833.10	827.70	03.20	843.75	28.65	177	34	830	88	6	1153	9		25	119	2221	12.3	11.55	1343	878	2886	1030	
19	813.70	813.74	813.71	813.72	813.72	1 38	823.90	824.30	831.40	833.70	828.33	04.83	843.90	30.18	177	34	830	84	6	1153	9		31	133	2231	11.5	13.28	1428	834	2737	1030	
20	813.76	813.84	813.71	813.72	813.76	0 04	823.90	824.45	830.35	830.35	827.26	03.56	843.85	30.09	177	34	830	84	6	1153	9		31	131	2218	11.5	13.09	1378	840	2758	1030	
21	813.70	813.71	813.71	813.69	813.70	0 02	823.60	823.60	831.60	833.60	828.10	04.40	843.85	30.15	177	34	830	84	6	1153	9		31	131	2218	11.5	13.09	1378	840	2758	1030	
22	813.70	813.71	813.69	813.69	813.70	0 00	823.70	823.70	831.70	833.70	828.20	04.50	843.90	30.20	177	34	830	84	6	1153	9		31	131	2218	11.5	13.09	1378	840	2758	1030	
23	813.70	813.71	813.69	813.69	813.70	0 00	823.70	823.70	831.70	833.70	828.20	04.50	843.90	30.20	177	34	830	84	6	1153	9		31	131	2218	11.5	13.09	1378	840	2758	1030	
24	813.70	813.71	813.69	813.69	813.70	0 00	823.70	823.70	831.70	833.70	828.20	04.50	843.90	30.20	177	34	830	84	6	1153	9		31	131	2218	11.5	13.09	1378	840	2758	1030	
25	813.70	813.71	813.69	813.69	813.70	0 00	823.70	823.70	831.70	833.70	828.20	04.50	843.90	30.20	177	34	830	84	6	1153	9		31	131	2218	11.5	13.09	1378	840	2758	1030	
26	813.70	813.71	813.69	813.69	813.70	0 00	823.70	823.70	831.70	833.70	828.20	04.50	843.90	30.20	177	34	830	84	6	1153	9		31	131	2218	11.5	13.09	1378	840	2758	1030	
27	813.70	813.71	813.69	813.69	813.70	0 00	823.70	823.70	831.70	833.70	828.20	04.50	843.90	30.20	177	34	830	84	6	1153	9		31	131	2218	11.5	13.09	1378	840	2758	1030	
28	813.70	813.71	813.69	813.69	813.70	0 00	823.70	823.70	831.70	833.70	828.20	04.50	843.90	30.20	177	34	830	84	6	1153	9		31	131	2218	11.5	13.09	1378	840	2758	1030	
29	813.70	813.71	813.69	813.69	813.70	0 00	823.70	823.70	831.70	833.70	828.20	04.50	843.90	30.20	177	34	830	84	6	1153	9		31	131	2218	11.5	13.09	1378	840	2758	1030	
30	801.26	801.74	801.15	801.17	801.33	12	827.40	827.40	831.70	833.00	829.87	28.54	844.70	43.37	177	34	830	84	6	1153	10		31	131	2218	11.5	13.09	1378	840	2758	1030	
31	799.23	799.26	798.89	799.08	799.14	2 19	827.40	828.30	831.30	830.60	829.40	30.26	845.10	45.96	177	34	830	151	10	1906	11		31	179	2611	11.5	13.88	1496	1115	3611	1030	
1887 Jan.																															
1											829.70			49.07	177	34				1906	11		423	137	3702			1436	5632		Pumps stopped at 9.35 a. m.
2													842.00								12		423	147	3850		21.47	2293	1557	3913	
3													842.50	49.61							12		423	147	3927	2.1	21.47	2293	1634	4002	Pumps started at 1.10 p. m
4													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
5													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
6													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
7													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
8													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
9													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
10													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
11													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
12													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
13													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
14													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
15													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
16													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
17													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
18													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
19													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
20													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
21													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
22													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
23													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
24													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
25													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
26													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
27													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
28													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
29													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
30													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
31													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
Feb																															
1													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
2													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
3													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
4													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
5													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
6													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
7													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	
8													842.10								12		423	147	3927	2.1	21.47	2293	1634	4002	

REMARKS

Pumps stopped at 9.35 a. m.
Pumps started at 1.10 p. m
Pumps stopped at 4 p. m. and started at 7.05 p. m. Sand and mud.
Finished building crib at 10 a. m. Pumps stopped at 2.50 a. m. Sacking out (clay.
Caisson on clay
Finished concreting crib at 2.30 p. m
Began laying masonry in P. M
Set up clay hoist in p. m
Started clay hoist at 4.10 p. m
Clay hoist froze up at 10 a. m Started at 12.00 p. m
" " " " 4 a. m. " " 7.30 a. m. Stopped at 4 p. m. for
Sacking out. (repairs.
Started clay hoist at 11.45 a. m
Stopped clay hoist for repairs at 7.30 a. m
Started clay hoist at 12.15 p. m.
Pumps started at 9.45 a. m
Pumps stopped at 3 a. m.
Pumps started at 11.15 a. m.
Stopped clay hoist at 3.30 p. m. and started at 6.30 p. m,
" " " " " 2.00 p. m.
" " From 2.30 to 5.45 p. m. repairs. Raised clay hoist 5 p. m
Stopped clay hoist from 5.15 a. m. to 9.20 a. m. Repairs.

APPENDIX D.—Continued.

PIER III.—Continued.

Date	Elevations of Cutting Edge N E.	N W	S E	S W	Average	Number in 24 Hours	Elevations of Ground N. E.	N. W.	S. E	S. W	Average	Average Excavation under Caisson	Water Gauge	Depth Immersed	Weights: Caisson Timber	Caisson Iron	Caisson Concrete	Crib Timber	Crib Iron	Crib Concrete	Air Space	Masonry	Sand	Water	Total	Air Pressure Indicated.	Air Pressure Calculated.	Reaction due to Air Pressure	Net Weight	Surface in Contact	Average Weight per sq. ft. on surface exposed to friction	Remarks.
					C	D					E	F	G	H	Tons.	Tons.	Tons.	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Lbs.	K	L	M L×A Tons.	I M Tons	Sq. ft.	N÷O Lbs.	
1887 Feb																															
9	776 02	775 80	775.95	775 84	775.92	1 28	841.60	835 60	834.60	833 60	835 58		59 05	846.60	70 68	177	34	830	198	13	2541	20	807	357	980	5088	31	30 57	3262	2594	8376	620	Clay
10	775 90	775.80	775.87	775 86	775.86	0 06	835 00	834 90	836 30	836 30	835.48		59 64	846 30	70 44	177	34	830	198	13	2541	20	866	3944	284	5387	3	30 48	3255	2692	8340	636	Stopped clay hoist from 3.30 p. m. to 7.45 p. m. Gravel and Coarse Sand.
11	774 77	774 61	774.74	774 60	774.68	0 18	834 70	835 00	837 60	837 40	836 18		61 18	847 60	71 72	177	34	830	198	13	2541	21	916	4015	960	6225	5	31 20	3713	2554	8554	624	" at 12 40 p. m
12	774 74	774.62	774.72	774 60	774 65	0 01	836 20	835 90	836 20	835 60	835 98		62 12	848 15	71 70	177	34	830	198	13	2541	21	916	4030	1065	6325	32	31 03	3315	2720	8475	634	Started " at 5.30 p. m
13	774 74	774 62	774 73	774 60	774.67	0 00	836 90	836 40	836 30	836 30	836 48		62 48	848 45	71 78	177	34	830	198	13	2541	21	916	4045	1055	6347	32	31 05	3312	2738	8659	632	Stopped " at 5 30 p. m and started at 7 p. m.
14	773 63	773 51	773 63	773 49	773 56	1 11	835 30	834 60	835 10	834 80	835 00		63 10	848 50	71 74	177	34	830	198	13	2541	21	916	4060	1045	6347	32 5	31 17	3360	2744	8634	637	Working in Pier II. Lat 10 30 a m Lat 11 30 a m Shift
15	773 44	773 32	773 44	773 31	773 37	0 19	834 80	834 30	835 00	834 60	834 68		64 68	848 55	71 78	177	34	830	198	13	2541	22	916	4075	1035	6351	32	31 17	3371	2773	8676	639	Started " at 7.00 a. m. and stopped at 6 30 p m
16	772 68	771 56	772 81	772 67	772.07	1 30	836 30	836 30	835 70	835 30	835 45		64 35	849 45	72 35	177	34	830	198	13	2541	22	945	4090	1060	6358	32	32 17	3435	2803	8677	630	Working in P. II.
17	772 68	771 56	772 81	772 67	772.07	0 00	837 10	836 10	837 30	836 20	836 73		64 23	849 45	72 35	177	34	830	198	13	2541	22	1067	4177	1167	6526	32 4	32 7	3435	2891	8776	627	Started clay hoist at 9.10 a m
18	772 04	771 92	772.09	771 93	771.99	0 08	836 30	835 70	837 10	836 70	836.45		64 45	849 45	72 33	177	34	830	198	13	2541	22	1147	4189	1169	6568	32 5	32 37	3452	2956	8795	635	Stopped " at 8.45 a. m. and started at 3 p. m
19	772 03	771 89	772 03	771 91	771 96	0 03	836 30	835 80	837 30	836.80	836 73		64 73	849 45	72 31	177	34	830	198	13	2541	22	1150	4196	1169	6568	33	32 43	3463	3001	8762	686	" " " at 9.30 a m
20	771 93	771 83	771 96	771 89	771 90	0 06	836 30	836 30	835 30	835 30	835 80		65 10	849 45	72 29	177	34	830	198	13	2541	22	1159	4206	1167	6578	33	32 60	3483	3015	8786	684	
21	770 72	770 64	770.70	770 63	770.67	1 23	835 40	834 0	835 60	835 60	835 37		65 50	850 95	72 29	177	34	830	198	13	2541	22	1159	4206	1168	6578	34	33 26	3483	3033	8900	674	Working in Pier II.
22	770 70	770 63	770.70	770.63	770.67	0 00	835 40	835 40	836 20	836 30	835.83		65 83	850 95	72 29	177	34	830	198	13	2541	22	1159	4206	1168	6578	33 8	33 10	3437	3037	8932	671	
23	770 72	770 64	770 70	770 62	770 67	0 00	833 60	834 80	836 00	834 00	834 60		65 81	850 95	72 29	177	34	830	198	13	2541	22	1237	4284	1218	6693	34 5	33 30	3556	3031	8923	679	Started clay hoist at 7 a. m
24	770 71	770 64	770 63	770 62	770.67	0 00	836 90	834 40	838 40	834.20	836 48		65 52	850 95	72 29	177	34	830	198	13	2541	22	1249	4296	1300	6743	34 5	33 30	3556	3039	8964	667	
25	769 36	769 29	769 37	769 34	769 34	1 33	836 10	834 60	838 30	835 10	836 78		65 18	847 60	78 26	177	34	830	198	13	2541	22	1249	4296	1218	6693	34 5	33 85	3515	3015	9173	666	
26	769 15	769 15	769 21	769 11	769.19	0 15	836 40	834 10	838 40	833 00	835 37		64 33	847 60	78 41	177	34	830	198	13	2541	22	1237	4284	1218	6693	34 5	33 8	3500	3006	9113	658	Stopped clay hoist at 8 a. m. and started at 12 m.
27	768 61	768 54	768.66	768 59	768 60	0 59	839 70	834 90	838 50	834 50	836 90		63 10	847 60	78 85	177	34	830	198	13	2541	22	1237	4284	1218	6693	35	34 20	3462	3061	9155	667	
28	768 27	768 23	768 25	768 16	768.24	1 36	835 60	833 40	841 20	833 30	835 38		67 04	847 30	79 06	177	34	830	198	13	2541	21	1259	4277	1237	6703	35 5	34 30	3462	3061	9141	667	Clay
May 1	768 02	767 96	768.00	768 10	768.00	0 24	836.00	837 70	834 20	833 10	834 45		66 55	847 25	79 25	177	34	830	198	13	2541	22	1259	4277	1237	6703	35	34 20	3462	3025	8988	673	Stopped clay hoist at 2.55 p. m. Cut off air at 5.55 p. m.
2	767 56	767 49	767 50	767 46	767 50	1 36	835.70	832 60	838 70	833 40	834 96		67 04	847 20	79 20	177	34	830	198	13	2541	22	1259									Work suspended. River breaking up
3	767 54	767 46	767 49	767 43	767 49	0 01	835 40	833 30	835 70	832 60	834 25		67 50	847 35	79 45	177	34	830	198	13	2541	22	1259									
4	767 52	767 47	767 47	767 46	767 48	0 01	835.60	832 20	836 60	833 60	834 12		67 63	847 40	79 57	177	34	830	198	13	2541	22	1259									
5	767 52	767 47	767 47	767 45	767 48	0 00	836.00	832 60	836 30	833 70	834 70		67 85	847 45	80 07	177	34	830	198	13	2541	22	1259									
6	767 52	767 47	767 48	767 45	767 48	0 00	835.70	832.70	836.20	836 30	835.82		68 10	847 40	79 92	177	34	830	198	13	2541	22	1259									
7																177	34	830	198	13	2541	22	1259									
8																177	34	830	198	13	2541	22	1259									
9																177	34	830	198	13	2541	22	1259								Ice went out at 4 50 p. m
10																177	34	830	198	13	2541	22	1259								
11	767 54	767 45	767 44	767 42	767 46	0 07								847 15	79 69	177	34	830	198	13	2541	22	1259								Put on air at 10.40 a. m. Started clay hoist at 3.25 p. m.
12	767 20	767 14	767 23	767 21	767 21	0 25								80 09	1	177	34	830	198	13	2541	22	1259	267	967	6518	35 5	34 40	3762	2487	7		Current too swift for soundings.
13														849 00		177	34	830	198	13	2541	22	1259				35 5	35 05	3742	2576	7262		
14														850 45		177	34	830	198	13	2541	22	1259				35 5	35 04	3742				Cut off air at 4.50 p. m Took boat ashore to coal up.
15																177	34	830	198	13	2541	22	1259				35 5	35 04	3742				Put on air at 5 52 p. m. Started clay hoist at 6 p. m.
16	766 23	766 17	766.35	766 36	766.28	3								84 17		177	34	830	198	13	2541	22	1259	370	1040	6743	36 3	36 42	3889	2554	5031	1014	
17	766 16	766 11	766 17	766 18	766.16	0 07								83 95		177	34	830	198	13	2541	22	1259									Stopped clay hoist at 11 40 p. m.
18	765.71	765.69	765.78	765.78	765.74	0 47								84 86		177	34	830	198	13	2541	22	1259									Cut off air at 7.40 a. m Abandoned Pier on account high water
19														851 15		177	34	830	198	13	2541	16	1259									Working in Pier II
20														851 15		177	34	830	198	13	2541	16	1259									
21														851 15		177	34	830	198	13	2541	16	1259									
22														849 40		177	34	830	198	13	2541	16	1259									
23	765.59	765 53	765 64	765.64	765.60	0 14								849.40	83 80	177	34	830	198	13	2541	16	1259									
24														849 40		177	34	830	198	13	2541	16	1259									
25														849 40		177	34	830	198	13	354	16	1259									
26														849 70		177	34	830	198	13	254	16	1259									
27														849 70		177	34	830	198	13	2541	16	1259									
28														850.00		177	34	830	198	13	2541	16	1259									
29														850 15		177	34	830	198	13	254	16	259									
30														850 30		177	34	830	198	13	254	16	259									
31														851 65		177	34	830	198	13	254	16	259									
June 1														853 10		177	34	830	198	13	2541	16	1259									
2														854 30		177	34	830	198	13	2541	16	259									
3														853 40		177	34	830	198	13	2541	16	259									
4	764.58	764.52	764.64	764.67	764.60	1 00								852 50		177	34	830	198	13	2541	16	1259									
5														851 75	87 15	177	34	830	198	13	2541	16	259	334	1076	6558			6928	5454	2402		
6	764 59	764.54	764 63	764.68	764.61									853 70		177	34	830	198	13	2541	16	259									
7														851 15	86.54	177	34	830	198	13	2541	16	1259	379	1086	6533			6933	5389	2427		
8														851 50		177	34	830	198	13	2541	16	1259									
9														850.40		177	34	830	198	13	254	16	1256									
10														849 50		177	34	830	198	13	2541	16	125									
11														850 35		177	34	830	198	13	2241	16	1259									
12														851 60		177	34	830	198	13	2541	16	1259									
13														848.60		177	34	830	198	13	2541	16	1259									
14														849 70		177	34	830	198	13	2541	16	1259									
15	764 57	764 51	764 61	764 66	764.60									848 80	8.00	177	34	830	198	13	2541	16	1259									
16	764 58	764 52	764 64	764 64	764.60	0 00								848 80	84 20	177	34	830	198	13	2541	16	1259									
17	764 54	764 50	764 62	764 65	764 58	0 01								849 15	84.57	177	34	830	198	13	2541	22	1259	345	1043	6462	36 5	36 59	3907	2555	4116	1000	
18	764 54	764 52	764 63	764 65	764 59									849 80	85.21	177	34	830	198	13	2541	22	1259	355	1060	6504	36 4	36 43	3896	2549	4116	996	
19	764 52	764 51	764 53	764 54	764.47	0 12								850 10	85.63	177	34	830	198	13	2541	22	1259	362	1068	6552	36 5	37 05	3956	2548	4123	959	
20	763 91	763 90	764 00	763 96	763.95	0 52								850 20	86.25	177	34	830	198	13	2541	22	1259	377	1077	6528	36 5	37 33	3956	2542	5387	944	Stopped clay hoist at 12 45 p. m. Started to [illegible] at 1 45 p. m.
21	763 52	763 50	763 61	763 63	763 57	0 38								849 85	86 98	177	34	830	198	13	2541	22	1259									Lost a scow load of [illegible]
22														849 70		177	34	830	198	13	2541	22	1259									
23														850 70		177	34	830	198	13	2541	22	1259									
24														850 30		177	34	830	198	13	2541	22	1259									
25														850		177	34	830	198	13	2541	22	1259									
26	763 57	763 49	763.60	763 61	763 57	0 01								849 70	85.33	177	34	830	198	13	2541	22	1259									
27														850 15		177	34	830	198	13	2541	22	1259									
28	763 52	763 50	763 59	763 45	763 53	0 04								848 15	84.62	177	34	830	198	13	2541											Finished sealing caisson at 1 a. m. Cut off air at 8.10 a. m.

APPENDIX D.—Continued.

RECORD OF SINKING CAISSONS. PIER IV.

Date	Elevations of Cutting Edge: N.E.	N.W.	S.E.	S.W.	Average	Slope in Inches	Elevations of Ground: N.E.	N.W.	S.E.	S.W.	Average.	Average Penetration	Weight	Depth Immersed	Weights: Caisson: Timber	Caisson: Iron	Caisson: Concrete	Crib: Timber	Crib: Iron	Crib: Concrete	Air Lock Shaft: Masonry	Air Lock Shaft: Sand.	Total	Air Pressure: Indicated	Air Pressure: Calculated	Air Lock Shaft: Area	Air Lock Shaft: Air Weight	Surface of Contact	Average Weight per sq. ft. of Surface in Contact	Remarks
1886					C	D					E	F	G	H																
Aug.					Ft.							E—C Ft.		G—C Ft.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.							
18	846.99	847.11	847.05	847.05	847.05		—	—	—	—	847.00		846.70		—	—	—	—	—	—	7	—	7							
19	844.69	844.88	845.43	845.72	845.18	1.87					847.00	1.92	846.00	0.82	155	30					7	—	192							
20	844.69	844.88	845.43	845.72	845.18	0.00			—	—	847.00	1.92	845.80	0.62	155	30	36				7	—	228							
21	843.74	843.78	844.33	844.01	843.81	1.35					847.00	3.17	845.75	1.92	155	30	288	—			7		480							
22	842.62	842.36	843.01	842.75	842.68	1.08			—	—	847.00	4.05	845.80	3.05	155	30	185	35			7		412							
23	842.61	842.36	843.01	842.69	842.75	0.00					846.50	3.75	845.70	2.95	155	30	354	49	3		7	—	598							
24	841.21	841.28	841.92	841.51	841.60	1.15					846.70	5.00	845.60	4.00	155	30	336	49	3		7	—	580							
25	839.77	839.63	840.22	840.02	839.91	1.60					845.40	5.51	845.40	5.51	155	30	390	56	3		7	—	636							
26	837.00	837.02	838.00	838.01	837.51	2.40					845.00	7.49	845.00	7.49	155	30	354	63	3		7	—	612							
27	836.87	837.05	836.50	836.70	836.84	0.67					845.30	8.46	845.20	8.36	155	30	336	71	3		7	—	594							
28	836.15	836.73	836.34	836.93	836.67	0.17	—	—	—	—	845.00	8.33	845.10	8.43	155	30	336	85	3		7	—	594							
29	833.74	833.83	833.74	833.93	833.81	2.86					845.00	10.24	845.00	11.14	155	30	354	99	3		7	—	612							
30	833.27	832.51	833.55	833.76	833.26	0.55					845.00	11.73	844.50	11.23	155	30	443	85	5	136	7	—	861							
31	830.42	830.57	830.80	831.32	830.80	2.34	843.30	844.10	844.50	844.90	844.20	13.40	844.10	13.30	155	30	443	85	5	136	7	—	861							Gumbo
844.05							844.05	844.85	844.85	844.85	844.85	14.05	844.85	14.05	155	30	443	85	5	136	7	—	861							
Sept.																														
1	837.69	837.84	838.09	838.13	838.01	2.75	844.70	844.02	846.89	844.88	845.12	17.77	844.80	16.79	155	30	443	85	5	286	7	—	1011							Sand
2	821.78	821.93	821.37	821.70	821.70	16.31	843.50	845.53	846.37	844.50	844.97	23.07	844.80	23.10	155	30	443	85	5	309	9	—	1136							
3	817.34	817.49	817.34	817.66	817.45	4.25	843.70	845.42	846.31	844.60	844.51	27.86	844.80	27.13	155	30	443	96	5	514	9	—	1253							
4	817.31	817.45	817.33	817.63	817.43	0.02	836.62	845.03	846.81	845.61	846.06	28.77	844.95	27.97	155	30	443	107	6	808	10	—	1582							
5	817.29	817.43	817.12	817.62	817.44		843.79	846.63	846.92	846.42	846.44	29.00	844.85	27.91	155	30	443	116	7	1018	10	—	1708							
6	810.06	810.33	809.98	810.42	810.15	7.29	837.30	842.43	844.78	842.31	842.71	32.07	844.70	34.55	155	30	443	136	7	1185	10	—	1975							
7	804.43	804.31	806.03	805.18	805.23		833.53	841.34	841.03	842.16	842.03	37.10	844.70	40.27	155	30	443	136	7	1305	10	—	2098							
8	801.99	801.97	802.87	802.16	802.45		832.44	841.47	844.37	841.36	842.32	41.89	844.70	42.75	155	30	443	174	9	1522	12	—	2350							
9	799.90	799.89	800.05	799.99	799.96		832.44	843.39	843.57	842.15	842.14	44.45	844.85	44.86	155	30	443	196	9	1637	12	—	2467							Clay in north end
10	798.75	798.71	798.91	799.12	798.90		832.44	843.71	844.51	842.17	842.69	45.75	845.05	45.95	155	30	443	196	11	1637	13	—	2467							Put on clay hoist
11	798.30	798.54	798.78	798.91	798.70	0.20	832.44	844.57	844.78	842.91	844.83	46.13	845.00	46.43	155	30	443	196	11	1750	16	—	2580							
12	798.80	798.24	798.39	798.51	798.35	0.35	844.36	845.74	844.89	843.74	844.68	46.25	845.00	46.45	155	30	443	196	11	1750	18	—	2580							
13	797.89	797.91	797.92	798.05	797.94		844.36	844.91	844.92	844.55	844.93	48.13	845.10	47.55	155	30	443	196	11	1750	18	—	2580							
14	796.50	796.17	796.73	796.87	796.57		843.98	845.73	845.86	845.36	845.23	48.13	844.90	48.53	155	30	443	196	11	1750	18	—	2580							
15	796.07	796.06	796.70	796.88	796.68	0.06	843.98	845.06	845.71	846.36	845.28	48.13	844.80	47.92	155	30	443	196	11	1750	18	—	2580							
16	795.50	795.47	795.44	795.53	795.49	1.89	844.03	845.72	845.74	845.05	845.12	49.05	844.80	49.31	155	30	443	196	11	1750	18	—	2580							
17	793.50	793.40	795.45	795.45	795.45	2.04	844.50	846.26	844.76	846.04	845.39	50.20	844.70	49.21	155	30	443	196	11	1750	18	—	2580							
18	794.18	794.15	794.25	794.25	794.21		843.50	845.85	845.65	845.60	845.61	51.61	844.60	50.45	155	30	443	196	11	1912	18	—	2743							
19	794.07	794.02	794.17	794.10	794.14	0.11	843.58	845.85	845.92	845.61	845.66	51.52	844.45	50.21	155	30	443	196	11	1912	18	—	2743							
20	793.50	793.80	794.20	793.97	793.87	0.27	843.40	844.76	845.10	844.11	845.59	51.55	844.40	50.43	155	30	443	196	11	1912	18	—	2743							
21	792.74	792.80	792.91	793.03	792.87	1.00	843.40	844.76	845.01	844.11	845.56	51.56	844.30	50.48	155	30	443	196	11	1912	18	—	2743							
22	792.74	792.70	792.91	793.01	792.84	0.03	843.24	845.10	845.61	845.03	845.44	52.60	844.30	51.46	155	30	443	196	11	1912	18	—	2743							Stopped clay hoist at 7:20 a. m. Cracked on one side.
23	791.03	791.03	791.07	791.39	791.08	1.76	843.03	845.33	845.37	845.30	845.11	52.03	844.20	51.07	155	30	443	196	11	1912	18	—	2743							
24	791.00	791.00	791.04	791.05	791.02	0.06	843.03	845.33	845.37	845.53	845.31	54.06	844.25	53.10	155	30	443	205	12	1973	18	—	2832							Clay hoist repaired at 8:15 p. m.
25	790.97	790.93	791.00	791.08	791.00	0.02	843.03	845.45	845.32	845.07	845.16	54.10	844.30	53.28	155	30	443	205	12	1973	18	—	2832							
26	790.95	790.92	791.00	790.96	790.95	0.05	843.00	845.44	845.32	845.16	845.13	54.10	844.30	53.30	155	30	443	205	12	1973	19	—	2832							
27	789.55	789.50	789.47	789.47	789.50	1.45	842.44	844.49	844.16	845.47	845.12	54.44	844.60	54.85	155	30	443	214	12	1973	19	—	2832							
28	789.53	789.53	789.55	789.60	789.55	0.05	842.50	844.03	844.20	844.33	844.02	55.31	844.45	55.92	155	30	443	214	12	2026	19	—	2944							
29	787.74	787.74	787.72	787.88	787.77	1.78	843.25	845.06	844.76	844.96	844.76	56.46	844.35	56.98	155	30	443	214	12	2066	19	—	3003							
30	787.71	787.71	787.70	787.57	787.75	0.02	843.71	845.11	844.70	844.87	844.60	56.85	844.35	56.60	155	30	443	214	12	2066	19	—	3003							
Oct.																														
1	787.70	787.70	787.70	787.86	787.74	0.01	843.71	845.11	844.70	844.87	844.60	56.86	844.60	56.86	155	30	443	214	13	2066	19	—	3003							Raised clay hoist.
2	786.35	786.39	786.37	786.43	786.42	1.32	843.05	845.49	844.77	844.95	844.66	58.04	844.75	58.14	155	30	443	216	13	2148	19	—	3085							
3	786.36	786.37	786.41	786.43	786.41	0.01	843.05	845.49	844.77	844.95	844.66	58.05	844.80	58.20	155	30	443	216	13	2705	19	—	3655							
4	786.34	786.35	786.34	786.39	786.39	0.02	843.24	845.36	845.34	844.82	844.96	58.57	844.55	58.16	155	30	443	232	13	2205	19	—	3234							
5	784.73	784.75	784.66	784.74	784.72	1.67	843.70	845.36	845.13	844.88	844.84	60.10	844.30	59.56	155	30	443	232	13	2205	19	—	3234							
6	784.70	784.70	784.64	784.71	784.69	0.03	843.70	845.49	845.34	844.82	844.84	60.42	844.70	59.99	155	30	443	232	13	2304	19	—	3333							
7	782.99	782.99	781.77	782.73	782.62	1.94	843.59	844.89	844.44	844.60	844.60	61.06	844.05	60.13	155	30	443	250	14	2394	19	—	3423							
8	782.66	782.94	782.74	782.91	782.81	0.03	843.59	844.44	844.60	844.60	844.60	61.71	844.35	61.06	155	30	443	252	15	2329	20	—	3422							
9	781.31	781.30	780.45	781.14	781.18	1.64	843.11	845.30	844.77	844.44	844.51	63.33	843.85	62.67	155	30	443	261	15	2466	20	—	3509							Stopped clay hoist at 3 p. m.
10	781.30	781.29	781.26	781.17	781.26	0.01	843.11	845.30	845.26	844.98	844.94	63.34	843.85	62.68	155	30	443	254	15	2607	20	—	3650							Sand and gravel. Started water pumps at 7 a. m
11	780.04	780.03	779.78	779.95	779.95	1.31	842.94	844.42	844.60	844.44	844.47	64.52	843.80	63.85	155	30	443	254	15	2607	20	—	3650							
12	777.98	777.95	777.98	778.06	777.98	1.97	843.09	845.03	843.92	844.36	844.33	66.35	843.80	65.83	155	30	443	256	15	2627	15	—	3669							Started clay hoist at 8 p. m.
13	777.93	777.85	777.93	777.93	777.91	0.04	842.59	845.03	844.38	844.36	844.34	66.37	843.80	65.87	155	30	443	272	16	2689	15	—	3732							
14	775.93	775.87	775.93	776.07	775.95	1.96	842.44	844.47	844.32	844.33	844.37	68.30	843.85	67.85	155	30	443	272	16	2662	21	—	3731							
15	775.92	775.86	775.92	776.05	775.94	0.01	842.44	844.47	844.32	844.33	844.37	68.31	843.85	68.01	155	30	443	272	16	2772	21	—	3731							Gravel
16	773.78	773.74	773.81	773.94	773.82	2.13	842.34	844.04	843.81	843.91	843.93	70.47	843.95	70.03	155	30	443	272	16	2829	21	—	3731							
17	773.78	773.74	773.80	773.94	773.82	0.00	842.34	844.04	843.81	843.91	843.93	70.47	843.95	70.03	155	30	443	272	16	2829	21	—	3731							
18	773.79	773.74	773.80	773.93	773.81	0.01	842.34	844.04	843.81	843.91	843.93	70.48	843.85	70.04	155	30	443	272	16	2829	21	—	3731							
19	771.63	771.56	771.69	771.67	771.64	2.17	842.34	843.80	843.81	843.91	843.84	72.45	843.90	72.11	155	30	443	286	16	2940	21	—	3883							
20	771.62	771.55	771.69	771.67	771.63	0.01	842.34	843.80	843.81	843.91	843.84	72.46	843.90	72.23	155	30	443	286	16	2940	21	—	3883							
21	771.61	771.53	771.67	771.81	771.66	0.01	842.34	845.21	842.59	843.67	843.60	72.24	843.90	73.24	155	30	443	296	17	3043	22	—	4002							
22	770.34	770.28	770.39	770.53	770.38	1.27	843.84	844.28	842.36	843.91	843.60	73.48	843.55	73.95	155	30	443	303	17	3113	22	—	4092							
23	770.29	770.24	770.35	770.54	770.34	0.04	843.84	844.28	842.40	843.91	843.61	73.33	843.55	74.00	155	30	443	303	17	3178	22	—	4181							
24	770.28	770.24	770.34	770.48	770.33	0.01	843.84	844.28	842.36	843.91	843.57	73.34	844.00	73.67	155	30	443	303	17	3178	22	—	4181							
25	770.27	770.22	770.33	770.48	770.33	0.00	843.84	844.98	842.39	843.93	843.67	73.34	844.00	73.67	155	30	443	303	17	3147	22	—	4150							
26	769.75	769.70	769.81	769.97	769.81	0.52	844.55	845.10	843.71	844.36	844.43	74.40	844.30	74.50	155	30	443	303	17	3147	22	—	4150							
27	768.21	768.16	768.28	768.45	768.27	1.54	844.55	845.50	843.46	844.05	844.39	75.95	844.20	75.95	155	30	443	303	17	3197	22	—	4197							
28	768.20	768.16	768.32	768.38	768.27	0.00	844.74	845.36	842.44	844.04	844.03	75.96	844.20	75.96	155	30	443	303	17	3223	22	—	4223							
29	767.46	767.40	767.42	767.57	767.46	0.75	844.60	844.30	842.51	844.57	844.24	76.73	844.00	76.54	155	30	443	303	17	3223	22	—	4223							Reached clay on west side.
30	767.38	767.33	767.34	767.49	767.38	0.08	844.60	844.30	842.52	845.57	844.19	77.12	844.00	76.96	155	30	443	303	17	3223	22	—	4223							
31	767.05	767.09	767.00	767.14	767.04	0.34	844.78	844.19	842.70	843.64	843.45	77.36	844.00	76.96	155	30	443	303	17	3223	22	—	4223							
Nov.																														
1	766.83	766.78	766.78	766.93	766.83	0.22	845.33	843.76	842.48	843.63	843.88	77.05	844.13	77.12	155	30	443	303	17	3223	22	—	4223	980	5181	35 5	33 3	3.7	7004	10.70	365	
2	766.19	766.14	765.24	765.28	765.71	0.64	845.13	843.74	842.54	842.98	843.60	77.50	843.65	77.66	155	30	443	303	17	3223	22	—	4223	978	5165	35 5	33 10	3.7	7004	10.70	365	
3	766.16	766.13	766.13	766.17	766.18	0.01	845.15	843.64	842.54	842.68	843.60	77.51	843.60	77.02	155	30	443	303	17	3223	22	—	4223	978	5165	35 5	33 8	3.7	7004	10.70	365	Took off clay hoist
4	766.07	766.02	766.00	766.14	766.06	0	843.47	844.15	842.00	843.14	842.79	77.50	843.85	77.35	155	30	443	303	17	3223	22	—	4223	980	5181	35 5	33 6	3.7	7004	10.70	365	Began concreting at 11 25 a. m
5	765.15	765.08	765.07	765.21	765.13	0.93	847.65	844.08		842.87	843.20	78.07	843.85	78.37	155	30	443	303	17	3223	16	—	4223	980	5181	35 5	34 36	3.7	7004	10.70	365	
6		—	—	—				—	—	—			844.00		155	30	443	303	17	3223	16					35						
7		—	—	—				—	—	—			844.00		155	30	443	303	17	3223	16					35						
8													844.00		155	30	443	303	17	3221	16	—				34 5						Finished filling caisson at 8 30 p m Took off air at 7 30 a m
9	765.10	765.06	765.02	765.17	765.09	0.04							844.10		155	30	443	303	17												

APPENDIX E.

TIME, COST AND MATERIALS USED IN FOUNDATIONS. PIER I.

Date.	Principal Foreman		Night Foreman.		Sub Foremen		Lock Tenders		Pressure Men		Coffeehouse Men		Coffee		Sugar		Candles		Red Lead		Wick		Coal for Heating 200 lbs		Linseed Oil		Ditching Outside	
1886	Days	Amount.	Days	Amount.	Days	Amount.	Days	Amount.	Days	Amount	Days	Amount	Lbs	Amount	Lbs	Amount	No	Amount	Lbs	Amount	Lbs	Amount	Boxes	Amount	Pints	Amount	Days	Amount
Feb																			70	4 70					24	1.50		
20	1	6.00	1	3.57	3	9.00	2	4.50	26	58.50	1	1.50	5	0.63	5	0.31	31	0.39					1	0.31	–			—
21	1	6.00	1	3.57	3	9.00	2	4.50	24	54.00	2	3.00	2½	0.31	5	0.32	24	0.30			—	—	1	0.32				
22	1	6.00	1	3.57	3	9.00	2	4.50	27^{5}	61.87	2	3.00	2½	0.37	5	0.31	41	0.51	1½	0.09		–	1	0.31	1	0.06		—
23	1	6.00	1	3.57	3	9.00	2	4.50	25	56.25	2	3.00	2½	0.31	5	0.32	30	0.38	2½	0.15	½	0.09	1	0.32	1	0.06		
24	1	6.00	1	3.57	3	9.00	2	4.50	22	49.50	2	3.00	2¼	0.28	10	0.63	22	0.28				-	1	0.31				
25	1	6.00	1	3.57	2	6.00	2	4.50	25	56.25	2	3.00	2¼	0.28	5	0.31	14	0.18	1½	0.09			1	0.32		0.07		
26	1	6.00	1	3.57	3	9.00	2	4.50	24	54.00	2	3.00	2½	0.32	10	0.63	24	0.30				-						
27	1	6.00	1	3.57	2	6.00	2	4.50	18	40.50	2	3.00	2½	0.31	5	0.31	9	0.11	..					0.31				.
28	1	6.00	1	3.57	2	6.00	2	4.50	23	51.75	2	3.00	2½	0.32	5	0.32	21	0.26			—	—	1	0.32			--	
Mar.																												
1	1	6.00	1	3.22	3	9.00	2	4.50	27	60.75	2	3.00	2¼	0.31	10	0.63	36	0.45					1	0.31			5^{4}	8.10
2	1	6.00	1	3.22	3	9.00	2	4.50	27	61.50	2	3.00	2½	0.32	5	0.32	29	0.36	5	0.30	½	0.10	1	0.32	2	0.13	9^{4}	13.50
3	1	6.00	1	3.22	3	9.00	2	4.50	27	61.50	2	3.00	2	0.25	5	0.31	27	0.34					1	0.31			4	19.60
4	1	6.00	1	3.22	3	9.50	2	5.00	29	70.75	2	3.00	4	0.50	10	0.63	42	0.53	5	0.30	½	0.09	1	0.32	2	0.12	5	12.02
5	1	6.00	1	3.22	4	13.00	2	5.00	35	87.50	2	3.00	2	0.25	10	0.63	32	0.40				—	1	0.31			5^{4}	8.41
6	1	6.00	1	3.22	4	13.00	2	5.00	35	87.50	2	3.00	5	0.62	10	0.63	42	0.53					1	0.32			5^{2}	7.28
7	1	6.00	1	3.22	4	13.00	2	5.00	33	82.50	2	3.00	2½	0.31	5	0.31	36	0.45			—	—					6^{6}	9.10
8	1	6.00	1	3.22	4	13.00	2	5.00	31	77.50	2	3.00	5	0.63	5	0.32	18	0.23	—				1	0.34			[illegible]	19.13
9	1	6.00	1	3.22	4	13.00	2	5.00	33	82.50	2	3.00	2½	0.37	10	0.63	31	0.39		—			1	0.34			[illegible]	16.23
10	1	6.00	1	3.22	4	13.00	2	5.00	18	45.00	2	3.00	2	0.25	5	0.31	2	0.03					1	0.34			19	44.74
11	1	6.00	1	3.22	—	—	2	5.00	—	—	2	3.00	—		—		7	0.09		—				0.34				
12	1	6.00	1	3.22	2	6.50	2	5.06	16	40.00	2	3.00	4	0.50	10	0.63	13	0.16	—		—			0.34			$3^{"}$	4.62
13	1	6.00	1	3.27	4	13.00	2	5.00	32	80.00	2	3.00	2½	0.31	5	0.37	12	0.15		.		—		—			$7^{"}$	10.92
14	1	6.00	1	3.23	4	13.00	2	5.00	32	80.00	2	3.00	4½	0.57	5	0.31	20	0.25	5	0.30	½	0.10	1	0.34	2	0.13	9^{8}	13.44
15	1	6.00	1	3.23	4	13.00	2	5.00	34	85.00	2	3.00	4½	0.56	6	0.38	9	6.1				—		0.34			18	25.75
16	1	6.00	1	3.23	4	13.00	2	5.00	33	82.50	2	3.00	2½	0.32	10	0.63	6	0.08	—				-				$7^{"}$	11.05
17	1	6.00	1	3.33	4	13.00	2	5.00	31	76.50	2	3.00	4½	0.57	5	0.31	6	0.07	5	0.30	½	0.09	1	0.31	2	0.13	1	15.40
18	1	6.00	1	3.23	4	13.00	2	5.00	34	85.00	2	3.00	4½	0.59	5	0.32	8	0.10						0.32		.	8^{2}	12.33
19	1	6.00	1	3.23	4	13.00	2	5.00	39^{5}	98.75	2	3.00	4½	0.63	10	0.63	6	0.08		—			1	0.31				
20	1	6.00	1	3.23	5	16.25	2	5.00	44^{5}	111.25	2	2.00	4½	0.64	5	0.31	4	0.05	—				1	0.32				
21	1	6.00	1	3.23	6	19.50	2	5.00	46	115.00	2	3.00	4½	0.63	10	0.63			5	0.30	½	0.10	1	0.31	2	0.13		
22	1	6.00	1	3.23	6	19.50	2	5.00	51^{6}	128.75	2	3.00	4¾	0.66	10	0.63	12	0.15	—				1	0.31				
23	1	6.00	1	3.23	6	19.50	2	5.00	53^{5}	133.75	2	3.00	4¾	0.67	10	0.63	6	0.07					1	0.32		—		
24	1	6.00	1	3.23	6	19.50	2	5.00	53	132.50	2	3.00	5	0.70	5	0.32	5	0.06		—		—	1	0.32				
25	1	6.00	1	3.23	6	19.50	2	5.00	54	135.00	2	3.00	5	0.70	10	0.63	10	0.12						0.31				
26	1	6.00	1	3.23	6	19.50	2	5.00	55	137.50	2	3.00	5	0.70	5	0.31	.					—	1	0.32			—	
27	1	6.00	1	3.23	6	19.50	2	5.00	[illegible]	131.25	2	3.00	5	0.70	10	0.63	6	0.08			—	—	1	0.31				
28	1	6.00	1	3.23	6	19.50	2	5.00	54	135.00	2	3.00	5	0.70	5	0.32	—		—		—	—	1	0.32				
29	1	6.00	1	3.23	6	19.50	2	5.00	55	137.50	2	3.00	5	0.70	10	0.63					—	—	1	0.31				
30	1	6.00	1	3.23	6	19.50	2	5.00	53	132.50	2	3.00	5½	0.77	10	0.63	3	0.04	—	-	—		1	0.32		—		
31	1	6.00	1	3.23	6	19.50	2	5.00	54	135.00	2	3.00	4¾	0.66	10	0.63	6	0.07	—		—		1	0.31	-		—	
Apr																												
1	1	6.00	1	3.33	6	19.50	2	5.00	51^{6}	128.75	2	3.00	5½	0.77	5	0.31	2	0.02	—	—			1	0.32				
2	1	6.00	1	3.33	6	19.50	2	5.00	54	135.00	2	3.00	5	0.70	10	0.63	10	0.13	—				1	0.31			—	
3	1	6.00	1	3.34	6	19.50	2	5.00	55	137.50	2	3.00	5¼	0.73	10	0.63	2	0.03	—	—			1	0.32				
4	1	6.00	1	3.33	6	19.50	2	5.00	55	137.50	2	3.00	5¼	0.74	10	0.63	6	0.08					1	0.31			—	
5	1	6.00	1	3.33	6	19.50	2	5.00	55	137.50	2	3.00	4½	0.63	5	0.32	12	0.15			—	—	1	0.32		—	—	
6	1	6.00	1	3.34	6	19.50	2	5.00	55	137.50	2	3.00	4½	0.64	10	0.63	—			—		—	2	0.63	—	—	—	—
7	1	6.00	1	3.33	6	19.50	2	5.00	56	140.00	2	3.00	2½	0.35	5	0.31		—				—	1	0.31		—		
8	1	6.00	1	3.33	6	19.50	2	5.00	53^{5}	133.75	2	3.00	4½	0.63	10	0.63	24	0.30		—			1	0.32				
9	1	6.00	1	3.34	6	19.50	2	5.00	55	137.50	2	3.00							-			—	-	—		—	—	
		294.00		162.13		690.25		239.00		4618.37		145.50		24.31		22.10		8.86		6.03		0.57		14.35		2.32		251.62

Date.	Day Engineer		Night Engineer		Firemen		Coal Passers		Pump Men		Laborers on Hoist		Coal for Boilers		Black Oil		Signal Oil		Tallow		Waste		Coal Oil.		Totals for Each Day	Feet Sunk per day	Material	Camerons Hrs Run	Camerons No of revolutions	Rev's of Air pumps	REMARKS.
1886	Days	Amount	Days	Amount	Days	Amount	Days	Amount	Days	Amount	Days	Amount	Tons	Amount	Pints	Amount	Pints	Amount	Lbs	Amount	Lbs	Amount	Pints	Amount							
Feb																									5.70						
20	2	7.30	1	1.50	2	4.80	1	2.10	1	2.40		—	7^{8}	23.94				—	14	0.91			8	0.11	127.77	2.17	sand	21⅔	38	—	
21	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			8^{2}	26.15	8	0.11	8	0.34	13	0.78		—	8	0.11	133.21	3.91	"	22 11/12	38	36	
22	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			7^{7}	24.57	16	0.22			15	0.98					139.71	3.45	"	22¼	38	29	
23	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			7^{8}	23.94	8	0.11			14	0.91	4	0.28	8	0.11	133.70	3.22	"	21 [illegible]/12	38	32	
24	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80		—	4^{8}	14.49	8	0.11	8	0.34	4	0.26			8	0.11	116.78	0.86	"	20 11/12	38	28	
25	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			6^{1}	19.22	16	0.22			8	0.52		—			124.93	2.26	"	23 11/12	39	27	
26	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	—	—	5	15.75	16	0.22	8	0.34	18	1.17	3	0.31	16	0.22	123.63	3.44	"	9⅚	40	15	
27	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			1^{5}	5.67	—				4	0.26	½	0.04	16	0.22	95.20	0.00	"			15	
28	2	7.30		3.30	2	4.80	2	4.20	1	2.40		—	3	9.45	16	0.22		—	4	0.26			16	0.22	108.19	0.30	"	5 [illegible]/12	37	11	
Mar.																															
1	2	7.30	1	3.30	2	4.80	2	4.20	1	2.40			5^{6}	17.33	—				12	0.78			8	0.11	136.49	4.94	"	19½	36	19	
2	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	—	—	7	22.05	8	0.11			9	0.59	1	0.07	8	0.11	149.90	4.77	"	21	38	28	
3	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			6^{8}	21.42	16	0.22	–		10	0.65			16	0.22	154.94	4.32	"	24	37	22	
4	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	—		6^{8}	19.53		—					1	0.26		-	156.19	2.02	"	24	36	35	
5	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			5	15.75	8	0.11	8	0.34	12	0.78	1	0.07	8	0.11	169.28	2.14	"	20 [illegible]/12	36	29	
6	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	—	—	6	18.90	8	0.11							8	0.11	170.62	0.03	"	24	35	38	
7	3	[illegible]	1	3.30	2	4.80	2	4.20	2	4.80	--		6^{6}	21.26	16	0.22	-	—	4	0.26					173.05	1.72	"	21	36	39	
8	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80		—	5^{9}	20.06	-	—			4	0.26	½	0.03	—	—	173.12	0.00	"	16 5/6	35	30	
9	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	3^{1}	4.47	4^{8}	16.37			–		9	0.59					176.41	0.02	"	5 1/12	37	29	
10	3	11.30	1	3.30	2	4.80	2	4.30	2	4.80	6^{1}	9.39	3^{9}	13.36	8	0.11			2	0.13			16	0.22	172.40	0.00	"			31	
11	2	7.30	1	3.30	2	4.80	2	4.20	1	2.40		-	3^{6}	11.90			8	0.50	4	0.26	2	0.14			52.45	1.44	"		—	41	
12	2	7.30	1	3.30	2	4.80	2	4.20	1	2.40	1	1.40	6^{7}	22.78			8	0.34	2	1.13			—		116.62	0.02	"	23⅔	36	42	
13	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	4^{5}	6.30	6^{6}	23.17		—	8	0.50	9	0.59		—		—	176.83	2.25	"	22 6/12	35	42	
14	2	7.30	1	3.30	2	4.80	2	4.30	2	4.80	4^{1}	5.74	7^{1}	24.14	8	0.11	–		5	0.33	2	0.14	-		180.53	2.13	"	23¼	37	41	
15	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	3^{5}	4.90	8^{7}	29.58		—		—	8	0.52			8	0.11	201.88	2.54	"	23 7/12	38	39	
16	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	4^{4}	6.16	8^{8}	27.82					4	0.26	-		—		183.45	2.29	"	21 7/12	36	38	[pumps.
17	2	7.30	1	3.30	2	5.40	2	4.20	2	4.80		—	7	23.63	8	0.11			12	0.78		—		—	174.42	1.44	clay	23 [illegible]/12	70	38	Clay hoist substituted for Cameron
18	2	7.30	1	3.30	2	5.40	2	4.30	2	4.80	7^{2}	10.[illegible]3	4^{5}	13.86	8	0.11			2	0.13	—		—		178.21	0.28	"	9 [illegible]/12	44	32	Pump men running clay hoist.
19	2	7.30	1	3.30	2	5.40	2	4.20	1	2.00	10	14.72	3^{1}	9.77		—	–		2	0.13		—	8	0.11	177.56	0.64	"			33	
20	2	7.30	1	3.30	2	5.40	2	4.20	2	4.00	10^{8}	16.07	3^{6}	8.19	—		–	—	2	0.13	--		—		194.64	0.00	"		—	18	
21	2	7.30	1	3.30	2	5.40	2	4.20			9^{8}	[illegible]	2^{4}	6.62	16	0.22	–		4	0.26		—			196.95	0.01	"			14	
22	2	7.30	1	3.30	2	5.40	2	4.30	2	4.00	9^{8}	13.44	2^{8}	8.19	—		–	—	2	0.13	1	0.07	—		213.26	0.00	"	—		24	
23	2	7.30	1	3.30	2	5.40	2	4.20	2^{2}	4.40	9^{4}	13.44	2^{9}	7.88	8	0.11	8	0.34	4	0.26					218.80	0.01	"			27	
24	2	7.30	1	3.30	2	5.40	2	4.20	1^{6}	3.20	10	14.00	3^{1}	9.77	8	0.11		—	3	0.19				—	218.10	0.02	"		—	35	
25	2	7.30	1	3.39		3.00	2	4.70	2	4.40	7^{8}	10.08	3^{6}	11.34		—	–		2	0.13	1	0.07			217.31	1.47	"	-	—	29	
26	2	7.30	1	3.30	2	5.40	2	4.20	2	4.80	7^{2}	10.08	3^{3}	10.40				-	2	0.13		-		—	223.17	0.00	"			24	
27	2	7.30	1	3.30	2	5.40	2	4.70	2	4.80	9^{2}	12.88	2^{6}	8.19	8	0.11			2	0.13	1	0.07	-		216.08	0.00	"	—	—	28	
28	2	7.30	1	3.30	2	5.40	2	4.20	2	4.80	9^{7}	13.58	3^{8}	10.40	16	0.22			5	0.33				—	222.60	1.33	"			26	
29	2	7.30	1	3.30	2	5.40	2	4.20	1	2.40	9^{8}	13.44	3^{8}	11.34		—			2	0.13					223.38	0.69	"			22	
30	2	7.30	1	3.30	2	5.40	2	4.20	2	4.80	9^{6}	13.44	1^{7}	5.36	8	0.11	8	0.50	4	0.26	1	0.07	8	0.11	215.84	0.01	"	—	-	34	Began excavation for test pit,
31	2	7.30	1	3.30	2	5.40	2	4.70	2	4.80	9^{6}	13.44	3^{4}	10.71	—	—	–		4	0.26		-	—		222.81	0.00	"			31	
Apr																															
1	2	7.30	1	3.30	2	4.80	2	4.70	2	4.80	9^{6}	13.44	4^{8}	13.55	8	0.11		—	4	0.26		—	8	0.11	218.87	0.00	"	-		36	
2	2	7.30	1	3.30	2	4.80	2	4.20	2	4.40	5^{8}	7.28	5^{6}	18.27	16	0.22	–		4	0.26	1	0.07	-	-	223.70	0.00	"		—	40	Reached gravel in test pit.
3	2	7.30	1	3.30	2	4.80	2	4.70	—		2	2.80	3^{9}	12.29	—				2	0.13	—		8	0.11	210.98	0.71	"	—		37	
4	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	9^{6}	13.44	5^{1}	16.07					4	0.26	—	—	—	—	230.26	1.00	"	—		37	
5	2	7.30	1	3.30	2	4.80	2	4.70	2	4.00	9^{6}	13.44	3^{1}	10.40				—	2	0.13					224.12	0.00	"			27	
6	2	7.30	1	3.30	2	4.80	2	4.20	1	2.40	9^{6}	13.44	3^{6}	9.14	16	0.22	8	0.34	2	0.13	1	0.07	—	—	221.58	0.07	"	—		31	Began sealing caisson at 9:45 p. m.
7	2	7.30	1	3.30	2	4.80	2	4.30					2^{9}	9.14					2	0.13	1	0.07			206.74	0.00	"			28	
8	2	7.30	1	3.30	2	4.80	2	4.20	—				1^{6}	4.73	8	0.11	–		2	0.13		—	8	0.11	197.11	0.00	"		—	20	
9	2	7.30		3.30	2	4.80	2	4.70					-	-	—	—			—			—	—	—	193.94	0.00	"	—		22	Finished sealing caisson at 5 a. m. Took air off at 2 15 p. m
		367.70		159.90		241.80		303.70		187.20		286.85		737.66		3.96		3.88		16.99		1.75		2.64	8693.44						

Other expenses charged to sinking . . $2229.48

$10922.92

TIME, COST AND MATERIALS USED IN FOUNDATIONS. PIER II.

APPENDIX E.—Continued.

PIER II.—Continued.

Date, 1887	Principal Foreman Days	Principal Foreman Amount	Night Foreman Days	Night Foreman Amount	Sub Foremen Days	Sub Foremen Amount	Lock Tenders Days	Lock Tenders Amount	Pressure Men Days	Pressure Men Amount	Coffee house Men Days	Coffee house Men Amount	Coffee Lbs	Coffee Amount	Sugar Lbs	Sugar Amount	Candles No	Candles Amount
April 15	—	—		—	—		—				—		—		—			—
16	—		—		—		—				—					—		
17								—			—							
18	—		—		—		—			—								—
19				—				—					—					
20			—				—											—
21					—									—				
22	—		—			—							—				—	—
23												—						
24		—		—			—										—	
25					—					—								
26			—	—			—		—				—				—	
27	1	6.00	1	3.34	3	9.75	2	5.00	32	80.00	2	3.00	3	0.47	4	0.26	5	0.06
28	1	6.00		3.33	4	13.00	2	5.00	42	105.00	2	3.00	3	0.70	4	0.26		
29	1	6.00	1	3.33	4	13.00	2	5.00	43	106.25	2	3.00	4	0.94	8	0.50	10	0.13
30	1	6.00	1	3.34	4	13.00	2	5.00	42	105.00	2	3.00	3	0.71	6	0.37	6	0.07
May 1	1	6.00	1	3.23	4	13.00	2	5.00	41	102.50	2	3.25	4	0.94	6	0.38	6	0.08
2		6.00		3.23	4	13.00	2	5.00	40	100.00	2	3.00	3	0.70	6	0.37	2	0.02
3	1	6.00	1	3.23	4	13.00		5.00	41	103.75	2	3.00	3	0.71	8	0.50	[illegible]	0.03
4	1	6.00		3.23	4	13.00	2	5.00	4[?]	10[?].50	2	3.00	4	0.94	6	0.38	3	0.04
5	1	6.00	1	3.23	4	13.00	2	5.00	42	106.25	2	3.00	3	0.70	6	0.37	8	0.10
6	1	6.00		3.23	4	13.00	2	5.00	43	107.50	2	3.00	4	0.96	4	0.25	8	0.10
7	1	6.00	1	3.23	5	16.25	2	5.00	53	133.75	2	3.00	5	[illegible]	8	0.50	3	0.04
8	1	6.00	1	3.23	6	19.50	2	5.00	63	157.50	2	3.00	5	1.28	10	0.63	3	0.04
9	1	6.00	1	3.23	6	19.50	2	5.00	65	[illegible]	2	3.00	4	1.02	6	0.37	3	0.04
10	1	6.00		3.23	6	19.50	2	5.00	60	151.25	2	3.00	5	1.27	8	0.50	1	0.01
11	1	6.00		3.23	6	19.50	2	5.00	[illegible]	[illegible]	2	3.00	4	1.02	8	0.50		
12	1	6.00	1	3.23	5	17.8[?]	2	5.00	59	147.50	2	3.00	5	[illegible]	8	0.50		
13	1	6.00		3.23	6	19.50	2	5.00	60	15[?].75	2	3.00	6	1.53	6	0.38	6	0.08
14	1	6.00	1	3.23	6	19.50	2	5.00	[illegible]	150.00	2	3.00	[illegible]	1.53	10	0.63	6	[illegible]
15	1	6.00		3.23	6	19.50	2	5.00	[illegible]	155.00	2	3.00	7	1.78	10	0.63	3	0.04
16	1	6.00	1	3.23	6	19.50	2	5.00	61	153.75	2	3.00	5	[illegible]	6	0.37	2	0.03
17	1	6.00	1	3.23	6	19.50	2	5.00	63	157.50	2	3.00	7	1.78	8	0.50	8	0.10
18		6.00		3.23	6	19.50	2	5.00	62	156.25	2	3.25	5	1.27	6	0.38	3	0.04
19		6.00	1	3.22	6	19.50	2	5.00	[illegible]	[?]3.75	2	3.25	4	1.02	8	0.50	6	0.07
20	1	6.00		3.22	6	19.50	2	5.00	57	143.75	2	3.25	4	1.02	6	0.37	6	0.08
21	1	6.00		3.22	4	13.00		5.00	55	13[?].75	2	3.25	4	1.02	4	0.25	6	0.07
22	1	6.00		3.22	4	13.00	2	5.00	60	151.25	2	3.25	6	1.53	8	0.50	3	0.04
23	1	6.00	1	3.22	5	16.25		5.00	64	160.00	2	3.25	5	1.28	6	0.38	6	0.08
24	1	6.00	1	3.22	6	19.50	2	5.00	63	158.75	2	3.25	6	1.53	8	0.50	2	0.03
25	1	6.00	1	3.22	6	19.50		5.00	61	152.50	2	3.25	4	1.02	8	0.50	8	0.10
26	1	6.00	1	3.22	6	19.50	2	5.00	61	153.75	2	3.25	6	1.65	8	0.50	2	0.02
27	1	6.00	1	3.22	6	19.50	2	5.00	61	153.75	2	3.25	6	1.65	8	0.50	[illegible]	[illegible]
28	1	[?].00		3.22	6	19.50	2	5.00	60	150.00	2	3.25	4	1.02	6	0.38		
29	1	6.00	1	3.22	6	19.50	2	5.00	61	152.50	2	3.25	5	1.37	4	0.25		
30	1	6.00	1	3.22	5	17.87	2	5.00	60	150.00	2	3.25	5	1.38	6	0.37		
31	1	6.00	1	3.22	5	17.88	2	5.00	60	150.00	2	3.25	5	1.37	7	0.44		
June 1	1	6.00	1	3.33	5	16.25	2	5.00	63	157.50	2	3.25	6	1.65	8	0.50	—	
2	1	6.00	1	3.33	5	16.25	2	5.00	59	148.75	2	3.25	4	1.10	6	0.37		
3	1	6.00		3.34	5	16.25	2	5.00	57	143.75	2	3.25	5	1.38	6	0.38	10	0.13
4	1	6.00		3.33	5	16.25	2	5.00	56	140.00	2	3.25	5	1.37	8	0.50	6	0.20
5	1	6.00		3.33	5	16.25	2	5.00	54	136.25	2	3.25	4	1.10	6	0.38	3	0.04
6		6.00	1	3.34	6	19.50	2	5.00	54	135.00	2	3.25	4	1.10	6	0.37		
7	1	6.00		3.33	6	19.50	2	5.00	57	143.75	2	3.25	5	1.38	6	0.38	8	0.10
8		6.00	1	3.33	5	16.25	2	5.00	56	141.25	2	3.25	5	1.37	6	0.37		
9	1	6.00		3.34	5	[illegible]	2	5.00	54	13[?].75	2	3.25	4	1.10	6	0.38	13	0.16
10	1	6.00	1	3.33	6	19.50	2	5.00	57	14[?].50	2	3.25	5	1.38	8	0.50	17	0.21
11	1	6.00		3.33	6	19.50	2	5.00	58	145.00	2	3.25	3	0.82	8	0.50	—	
12	1	6.00		3.34	6	19.50	2	5.00	[illegible]	143.75	2	3.25	3	0.83	4	0.25	3	0.04
13	1	6.00		3.33	6	19.50	2	5.00	55	137.50	2	3.25	11	[illegible]	6	0.37	3	0.04
14	1	6.00		3.33	6	19.50	2	5.00	54	135.00	2	3.25	7	1.78	8	0.50	8	0.10
15	1	6.00	1	3.33		19.50	2	5.00	52	130.00	2	3.15	4	0.80	4	0.25	1	0.01
16	1	6.00		3.33	6	19.50	2	5.00	54	136.25	2	3.25	3	0.60	4	0.25	9	0.11
17	1	6.00		3.33	6	19.50	2	5.00	55	13[?].25	2	3.25	3	0.60	4	0.25	3	0.04
18	1	6.00	1	3.33	6	19.50	2	5.00	54	135.00	2	3.25	2	0.40	2	0.13	13	0.16
19	½	3.00	1	3.34	3	9.75		3.75	30	76.25	2	3.25			—			
		505.41		276.39		1131.85		403.37		9152.17		258.25		86.37		34.70		6.57

Date, 1887	Red Lead Lbs	Red Lead Amount	Wick Lbs	Wick Amount	Coal for heating (200 lbs) Boxes	Coal for heating Amount	Linseed Oil Pints	Linseed Oil Amount	Day Engineers Days	Day Engineers Amount	Night Engineer Days	Night Engineer Amount	Firemen Days	Firemen Amount	Coal Passers Days	Coal Passers Amount	Pump Men Days	Pump Men Amount	Laborers on [illegible] Days	Laborers Amount	Coal for Boilers Tons	Coal for Boilers Amount
April 15		—		—	—			—					—			—			—		—	
16–26	—	—	—	—	—	—	—	—	—		—	—	—		—	—	—	—	—	—	—	—
27	4	0.24	4	0.05			2	0.12	2	7.60	1	3.30	2	4.80	2	4.20	1	2.40	2	3.40	5	11.35
28									1	4.60	1	3.30	2	4.80	2	4.20	2	4.80	9	16.32	5	11.35
29		—			2	0.45			2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	9	16.32	4	10.90
30							—		2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	9	16.32	5	17.00
May 1					3	1.02			2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	9	16.32	4	15.98
2			—		3	1.02			2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	9	16.32	4	15.98
3					—		—	—	2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	9	16.32	5	17.00
4		—			3	1.02			2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	9	16.2[?]	4	15.98
5									2	7.60		3.30	2	4.80	2	4.20	1	2.40	11	19.74	5	17.00
6	-	-			1	0.34			2	7.60	1	3.30	2	4.80	2	4.20	1	2.40	12	21.72	4	16.60
7									2	7.60		3.30	2	4.80	2	4.20	1	2.40	12	21.06	5	17.00
8							—	—	2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	11	19.44	5	17.00
9		—		—	1	0.34			2	7.60		3.30	2	4.80	2	4.20	2	4.80	9	16.32	4	16.66
10					—		—	—	2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	9	16.32	5	17.00
11				-					2	7.60		3.30	2	4.80	2	4.20	2	4.80	9	[?].32	5	17.00
12					-		—		2	7.60		3.30	2	4.80	2	4.20	2	4.80	9	16.32	5	17.00
13				—	1	0.34			2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	9	16.32	4	16.66
14					—				2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	10	17.51	5	17.00
15					1	0.34			2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	10	18.30	4	16.66
16	-				1	0.34			2	7.60		3.30	2	4.80	2	4.20	2	4.80	10	18.36	4	16.66
17									2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	10	18.36	5	17.00
18	—				4	1.36		—	2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	11	18.87	4	15.64
19							—	—	2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	10	18.36	5	17.00
20	—		-		3	1.02			2	7.60	1	3.35	2	4.80	2	4.20	2	4.80	10	17.16	4	15.98
21	4	0.24	4	0.05	1	0.34	2	0.12	2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	9	16.32	4	16.66
22					1	0.34		—	2	7.60		3.30	2	4.80	2	4.20	2	4.80	9	15.30	4	16.66
23					—		-	—	2	7.60		3.30	2	4.80	2	4.20	2	4.80	11	[illegible]	5	17.00
24									2	7.60		3.30	2	4.80	2	4.20	2	4.80	11	19.54	5	17.00
25	3	0.18	4	0.05	1	0.34	1	0.06	2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	10	18.39	4	16.66
26							-		2	7.60		3.30	2	4.80	2	4.20	2	4.80	12	20.[?]3	5	17.00
27					1	0.34			2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	11	[?].18	4	16.66
28				—	5	1.70			2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	[illegible]	[illegible]	4	15.30
29					—				2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	13	22.16	5	17.00
30				—				—	2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	13	21.46	5	17.00
31		—							2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	14	24.39	5	17.00
June 1		—			4	1.36			2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	14	24.48	4	15.64
2							—		2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	14	24.48	5	17.00
3	4	0.24	4	0.05			2	0.12	2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	14	24.48	5	17.00
4		—							2	7.60	1	3.30	2	4.80	2	4.20	1	2.40	14	24.48	5	17.00
5							—		2	7.60	1	3.30	2	4.80	2	4.20	1	2.40	14	24.48	5	17.00
6					4	1.36			2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	13	22.44	4	15.64
7					—	—	—		2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	[illegible]	[?]6.32	5	17.00
8									2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	7	12.24	5	17.00
9								—	2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	7	12.24	5	17.00
10				—			—		2	7.60	1	3.30	2	4.80	2	4.20	1	2.40	7	12.24	5	17.00
11		—						—	2	7.60	1	3.30	2	4.80	2	4.20	1	2.40			5	17.00
12									2	7.60	1	3.30	2	4.80	2	4.20	1	2.40			5	17.00
13		—							2	7.60	1	3.30	2	4.80	2	4.20		2.40			5	17.00
14					—				2	7.60	1	3.30	2	4.80	2	4.20		2.40			5	17.00
15		—			—		—	—	2	7.60	1	3.30	2	4.80	2	4.20					5	17.00
16									2	7.60	1	3.30	2	4.80	2	4.20	—				5	17.00
17		—			3	1.02	—	—	2	7.60	1	3.30	2	4.80	2	4.20		2.40			4	15.[?]
18									2	7.60	1	3.30	2	4.80	2	4.20	1	2.40			5	17.00
19				—	—			—	2	7.60	1	3.30	2	4.80	2	4.20	1	2.40				
		4.56		0.60		24.12		1.88		625.75		279.40		399.00		349.65		334.80		8[?]9.06		1533.25

Date, 1887	Signal Oil Pints	Signal Oil Amount	Black Oil Pints	Black Oil Amount	Tallow Lbs	Tallow Amount	Waste Lbs	Waste Amount	Coal Oil Pints	Coal Oil Amount	Totals for each day	Feet sunk per day	Material	Cameron Pumps Hours run	Cameron Pumps No. of revolutions	Air Pumps No. of revolutions	Remarks.
April 15				—					—	—		—	—	—	—	—	Working in Pier III.
16	—		—		—		—					—	—		—	—	" "
17									—			—	—		—	—	" "
18	—		—		—		—					—	—	—	—	—	" "
19			—				—					—	—	—	—	—	" "
20	—		—	—	—		—					—	—	—	—	—	" "
21			—		—	—	—					—	—	—	—		" "
22	—		—	—	—							—			—	—	" "
23			—					—				—		—	—	—	" "
24		—	—		—	—						—		—	—	—	" "
25			—				—					—	—	—	—	—	" "
26					—				—			—		—	—		" "
27	8	0.34	8	0.12			1	0.07			145.87	0.02	clay	—	-	24	
28			8	0.12			1	0.07	—		188.85	0.02	"	—	—	28	
29	—		8	0.12			1	0.07			190.71	1.19	"			23	
30			8	0.12			1	0.07	—		194.70	[?].54	"			27	
May 1	8	0.34	8	0.12	—	—	1	0.07	—		192.93	0.10	"			26	
2			8	0.12			1	0.07			189.53	1.30	"			21	
3	—		8	0.12	-		1	0.07	—	—	193.43	0.44	"			22	
4		—	8	0.12	-		1	0.07			192.23	0.17	"			22	
5	8	0.34	8	0.12			1	0.07		—	197.22	0.14	"			14	
6		-	8	0.10	-	—	1	0.07			200.25	0.92	"			13	
7			8	0.11	-		1	0.07			229.58	0.46	"			16	
8			8	0.10		—	1	0.07			257.49	0.35	"			23	
9	8	0.34	8	0.11	—		1	0.07			259.20	0.04	"		-	22	
10			8	0.10			1	0.07	—		247.95	1.53	"		—	25	
11		—	8	0.11	-		1	0.07			[?]3.95	0.[?]5	"			31	
12			8	0.10			1	0.07	8	0.11	[?]2.68	0.11	"			21	
13	8	0.34	8	0.11			1	0.07			248.51	0.44	"	—	.	21	
14			8	0.10	—		1	0.07			2[?]8.33	1.6[?]	"			26	
15			8	0.11			1	0.07			254.42	0.05	"	—		32	
16			8	0.10			1	0.07			252.38	0.01	"		-	29	
17	8	0.34	8	0.11	—		1	0.07			257.19	1.7[?]	"			28	
18	16	0.68	8	0.10	—		1	0.07			256.34	0.32	"			26	
19			8	0.11			1	0.07			252.55	0.13	"		—	28	
20			8	0.12			1	0.07			[illegible]	0.33	"			28	
21	—		8	0.12	—		1	0.07			[?]30.81	1.5[?]	"			22	
22			8	0.12	—		1	0.07	8	0.11	241.0[?]	0.84	"			25	
23	8	0.34	8	0.12	—		1	0.07			256.11	[illegible]	"			24	
24			8	0.12			1	[illegible]			[illegible]	0.55	"			22	
25			8	0.12	—		1	0.07	—		[illegible]	[illegible]	"			21	
26			8	0.12		-	1	0.07	8	0.11	255.32	[illegible]	gravel			25	
27	8	0.34	8	0.12			1	[illegible]	—		253.5[?]	[?].25	and			22	
28	—		8	0.12			1	0.07		—	[illegible]	[illegible]	sand			27	
29			8	0.12		—	1	0.07		—	25[?]	[illegible]	"			29	
30			8	0.12	—		1	0.07			250.44	1.68	"			32	
31			8	0.12	—		1	0.07	8	0.11	253.55	0.01	"	—		28	
June 1	8	0.34	8	0.12			1	0.07		—	260.19	1.68	"	—	-	33	
2			8	0.12	-	-	1	0.07			25[?]	0.55	"			33	
3			8	0.12			1	0.07			[illegible]	0.34	"			34	
4			8	0.12			1	0.07	8	[illegible]	239.98	1.16	clay,	-	—	33	
5	8	0.34	8	0.12		-	1	0.07			235[?]	0.07	"		-	26	
6	—		8	0.12			1	0.07		—	237.8[?]	0.47	"			27	
7			8	0.12	—		1	0.07			240.90	0.16	"			26	
8	-		8	0.12			1	0.07			230.95	0.30	"			24	
9	8	0.34	8	0.12			1	0.07	8	[illegible]	227.93	0.17	"	—	—	18	
10	—		8	0.12			1	0.07	-		233.40	0.02	"	-	-	27	
11	—		8	0.12			1	0.07			222.89					[illegible]	Began sealing caisson.
12			8	0.12			1	0.07		—	221.[?]5					25	
13			8	0.12			1	0.07			[?]7.50			-		23	
14	8	0.34	8	0.12			1	0.07	—		[?]14.2[?]			-	—	25	
15			8	0.12				0.07		—	205.2[?]					33	
16			8	0.12				0.07			211.38			—	—	21	
17			8	0.12	-		1	0.07			216.21				—	22	
18	8	0.34	8	0.12			1	0.07		—	21[?].59					23	
19											121.64			-		—	Took off air at 7.05 a. m.
		8.84		10.29		6.30		6.02		1.10	16259.70						

Other expenses charged to sinking . $2127.14

$18386.84

TIME, COST AND MATERIALS USED IN FOUNDATIONS. PIER III.

Date 1886	Principal Foreman Days	Principal Foreman Amount	Night Foreman Days	Night Foreman Amount	Sub Foremen Days	Sub Foremen Amount	Lock Tenders Days	Lock Tenders Amount	Pressure Men Days	Pressure Men Amount	Coffeehouse Men Days	Coffeehouse Men Amount	Coffee Lbs	Coffee Amount	Sugar Lbs	Sugar Amount	Candles No.	Candles Amount
Nov.																		
23	1	6.00	1	3.33	2	6.00	—		47⁵	91 87								—
24	0⁸	4 80	0⁸	2.67	2⁴	7.20		—	47⁵	90 27	—		—					
25	1	6.00	1	3.33	1	3 00			[illegible]	[illegible]				—				
26		—			—						—							
27				—	—			—					—					—
28		—	—	—	—		—	—			—	—	—			—		—
29	—				—		—						—					
30		—	—	—	—			—			—	—	—			—		—
Dec.																		
1		—		—	—			—		—	—	—	—		—	—	—	
2	—	—	—		—													
3	—							—					—					
4	1	6.00	1	3.23	1⁵	5 25	1	2.25	18	40 50	2	3 25	3	0 50	4	[illegible]	20	0 25
5	1	6 00	1	3 23	3	9 00	2	4.50	33	74 25	2	3 25	3	0 50	4	[illegible]	11	0 14
6	1	6 00	1	3 23	1	3.00	2	4 50	10⁵	23.63	2	3 25	2	0 33			6	0 08
7	1	6.00	1	3 23	1	3 00	2	4.50	4	9 00	2	3 25	2	0 34	4	0 26	2	0 03
8	1	6.00	1	3 23	2	6 00	2	4 50	25	56 25	2	3.25	3	0 50			3	0 04
9	1	6.00	1	3.33		1.50	2	4.50	16	36 00	2	3 25	2	0 33	6	0 41	4	0.05
10	1	6.00	1	3.23	1	3.00	2	4.50	4	[illegible]	2	3 25	2	0.34	4	0 24	4	0.05
11	1	6.00	1	3 23	3	9 00	3	6.75	33	74.25	3	4.75	5	0 84	4	0 24	6	0 07
12	1	6 00	1	3.23	3	9 00	2	4.50	30	67.50	2	3 25	4	0 67	4	0 24	7	0 08
13	1	6 00	1	3 23	3	9.00	2	4.50	30	67.50	2	3 25	5	0 84	9	0 54	3	0 04
14	1	6.00	1	3.23	1	3.00	2	4.50	16	36 00	1	1 5	4	0 67	4	0 24	1	0.01
15	1	6 00	1	3.23	1⁵	4.50	2	4 50	6	13 50	2	3 25	3	0 51	5	0 30	3	0 04
16	1	6.00	1	3.23	2	6 00	2	4.50	[illegible]	[illegible]	2	3 25	2	0 33			2	0.02
17	1	6.00		3.33			1	2 25	5	11.25	1	1.75	2	0 34	4	0 24		
18	1	6 00	1	3 23	2	6 00	2	4 50	15	33 75	1	[illegible]	2	0 33	5	0 30	11	0 14
19	1	6 00	1	3.22	1	3 00	2	4.50	6	13.50	2	3 25	2	0 34	5	0 30	3	0 03
20	1	6 00	1	3 22	1	3.00	2	4 50	4	9 00	2	3 25	3	0 50				
21	1	6 00	1	3.22	3	9 00	2	4.50	25	56.25	2	3.25	3	0.50	5	0 30	2	0 02
22	1	6 00	1	3 22	2	6 00	2	4.50	32	72.00	2	3.25	5	0 84	4	0 24		
23	1	6.00	1	3 22	1	3 00	2	4.50	11	24.75	2	3 25	3	0 51	5	0 30		
24	1	6.00	1	3.22	2	6 00	2	4.50	18	40.50	2	3 25	3	0 50	5	0 30		
25	1	6 00	1	3 22			1	2.25	4	9.00	1	1.75	2	0 33				
26	1	6.00	1	3 22	1	3 00	2	4.50	[illegible]	[illegible]	2	3 25	2	0 40				—
27	1	6 00	1	3 22		3.00	2	4.50	19	42 75	2	3 25	4	0 80	5	0 30	6	0 08
28	1	6 00	1	3 22	2	6 00	2	4.50	31	69 75	2	3.25	3	0 50	5	0 30		
29	1	6 00	1	3 22	1	3.00	2	4 50	20⁵	46.13	1⁵	2 37	3	0 60	5	0 30	17	[illegible]
30	1	6 00	1	3 22	2⁵	7 50	2	4.50	20⁵	46.13	2	3.25	4	0 80	5	0 30		
31	1	6 00	1	3.22	3	9 00	2	4.50	33	74 25	2	3 25	4	0 80	5	0 30		
1887 Jan.																		
1	1	6.00	1	3 23	1	4.88	2	5.00	13⁵	33.75	2	3.25	1	0.20	4	0 24	—	—
2	1	6.00	1	3 23	3	9 75	2	5 00	8	20 00	2	3 25	2	0 40	4	0 24	2	0 03
3	1	6 00	1	3 23	3	9 75	2	5.00	17⁵	43 75	2	3 25	2	0 40	4	0 24		
4	1	6 00	1	3 23	4	13.00	2	5.00	42	105 00	2	3 25	3	0 60	4	0 24	6	0.07
5	1	6 00	1	3 23	4	13.00	2	5.00	44	111.25	2	3.25	4	0 80	5	0 30	6	0 08
6	1	6 00	1	3 23	4	13.00	2	5.00	44⁵	111.25	2	3.25	3	0 60	3	0 18	3	0 04
7	1	6 00	1	3 23	4	13.00	2	5.00	43	108.75	2	3 25	2	0 40	5	0 30		—
8	1	6 00	1	3.23	4	13 00	2	5 00	43	108 75	2	3.25	6	1 20	8	0 48	2	0 03
9	1	6 00	1	3.23	4	13 00	2	5.00	42⁵	106.25	2	3 25	4	0 80	5	0 30	10	0 13
10	1	6.00	1	3 23	4	13 00	2	5.00	39	97.50	2	3.25	4	0 80	5	0 30		
11	1	6 00	1	3.23	4	13.00	2	5.00	41⁵	103 75	1	1 50	2	0 40	5	0.30	3	0 04
12	1	6 00	1	3.23	4	13.00	2	5.00	40⁵	101.25	2	3.25	6	1 20	4	0 24	2	0 03
13	1	6.00	1	3 23	4	13.00	2	5 00	40	100 00	2	3 25	3	0 60	8	0 60	6	0 07
14	1	6.00	1	3 23	4	13.00	2	5.00	41⁵	103.75	2	3.25	3	0 60	4	0 24	6	0.08
15	1	6 00	1	3 23	4	13.00	2	5.00	41	102.50	2	3.25	3	0 60	4	0 24		
16	1	6 00	1	3 23	4	13.00	2	5.00	42	105 00	2	3.25	4	0.80	4	0 24	6	0 07
17	1	6.00	1	3.23	4	13 00	2	5 00	40	100 00	2	3 25	3	0 60	4	0 24	10	0 13
18	1	6.00	1	3.23	4	13.00	2	5.00	35⁵	89 37	2	3 25	3	0 60	4	0 24		
19	1	6 00	1	3 22	4	13.00	2	5 00	34	85 00	2	3 25	4	0 80	4	0 24	3	0.04
20	1	6.00	1	3 22	5	16.25	2	5 00	47⁵	118 75	2	3 00	3	0 60	5	0 30	6	0.08
21	1	6.00	1	3.22	6	19 50	2	5 00	54	135 00	2	3 00	4	0 80	5	0.30		
22	1	6 00	1	3 22	6	19 50	2	5 00	56	141 25	2	3.00	5	1 00	10	0 60	2	0 02
23	1	6 00	1	3 22	6	19 50	2	5 00	59⁵	148 75	2	3.00	5	1 00	10	0 60	—	
24	1	6 00	1	3 22	6	19.50	2	5 00	61⁵	153 75	2	3 00	4	0 93	10	0 60	4	0 05
25	1	6.00	1	3.22	6	19.50	2	5.00	60⁵	151 25	2	3.00	5	0 82	10	0 60		
26	1	6.00	1	3 22	6	19 50	2	5 00	58	145 00	2	3.00	5	1 12	10	0.60	6	0.07
27	1	6.00	1	3 22	6	19 50	2	5.00	61	152 50	2	3.00	5	1 2	10	0 60	3	0.04
28	1	6.00	1	3 22	6	19 50	2	5 00	57⁵	143 75	2	3.00	4	0 90	5	0 30	3	0.04
29	1	6.00	1	3 22	6	19 50	2	5 00	61⁵	153 75	2	3.00	4	0 90	9	0 54	2	0 02
30	1	6.00	1	3 22	6	19 50	2	5 00	63	158 75	2	3.00	4	0 90	9	0 54	3	0 04
31	1	6.00	1	3.22	6	19 50	2	5.00	62⁵	156.25	2	3.00	4	0.90	5	0 30	3	0.04
Feb.																		
1	1	6 00	1	3.57	5⁵	17.88	2	5 00	62⁵	156 25	2	3 00	5	1 13	10	0 60	2	0.03
2	1	6.00	1	3 57	4	13.00	2	5 00	61⁵	153 75	2	3 00	5	1 13	10	0 60		
3	1	6.00	1	3 57	6	19 50	2	5 00	61⁵	153 75	2	3 00	2	0.67	6	0 30	4	0.05
4	1	6 00	1	3 57	6	19 50	2	5.00	61⁵	153 75	2	3 00	5	1 13	10	0 60	4	0 05
5	1	6.00	1	3 57	5⁵	17 87	2	5 00	62	155 00	2	3 00	5	1 13	10	0 60	4	0 05
6	1	6 00	1	3 57	6	19 50	2	5 00	58	145 00	2	3.00	4	0 90	5	0 30	2	0.03
7	1	6.00	1	3 85	6	19.50	2	5.00	61	152 50	2	3 00	5	1 13	10	0 62	3	0.04
8	1	6.00	1	3 57	6	19.50	2	5 00	58⁵	146 25	2	3 00	5	1 13	10	0 63		0 01
9	1	6 00	1	3 57	6	19 50	2	5 00	60⁵	151 25	2	3 00	4	0 90	10	0 63		
10	1	6 00	1	3.57	6	19.50	2	5 00	59⁵	148.75	2	3.00	6	1 35	10	0 64	2	0 02

Date	Red Lead Lbs	Red Lead Amount	Wick Lbs	Wick Amount	Coal for Heating Boxes	Coal for Heating Amount	Linseed Oil	Linseed Oil Amount	Day Engineer Days	Day Engineer Amount	Night Engineer Days	Night Engineer Amount	Firemen Days	Firemen Amount	Coal Passers Days	Coal Passers Amount	Pump Men Days	Pump Men Amount
Nov.																		
23	40	0.40		—			16	1.00										—
24				—	—													
25																		—
26				—	—													
27				—														
28	—		—									—						
29																		
30																		
Dec.																		
1				—	—													
2																		
3			—			—												
4	—				4	1.36			2	[illegible]			2	4 60	1	[illegible]	1	2.40
5									2	7.30		3.30	2	4 80	2	[illegible]	2	4 80
6	2	0.12	¼	0.05			½	0 04	2	7 30		3.30	2	4 80	2	4 20	2	4 80
7					2	0 68			2	7.30		3.30	2	4 80	2	4 20	2	4.80
8									2	7.30		3 30	2	4 80	2	[illegible]	2	4 80
9	2	0.12	¼	0.05	4	1.36	½	0 04	2	7.30		3.30	2	4.80	2	4 20	2	4.80
10									2	7.30		3.30	2	4.80	2	4 20	2	4.80
11		—							2⁵	8.95	1⁵	4.95	2	4.80	2	4 20	2	4.80
12			—		4	1 36	—		2	7.30		3 30	2	4 80	2	4.20	2	4 80
13						—			2	7.30		3 30	2	4.80	2	4.20	1⁵	2.80
14									2	7 30	1	3.30	2	4 80	2	4 20	2	4 80
15			—		2	0 68			2	7.30		3 30	2	[illegible]	2⁵	[illegible]	2⁵	[illegible]
16									2	7.30		3.30	2	4.80	2	4 20	2	4.80
17					5	1 70			2	7.30		3.30	2	4.80	2	4 20	2	4.80
18									2	7.30		3 30	2	4.80	2	4 20	1⁵	3 60
19									2	7 30		3 30	2	4 80	2	4 20	2	4 80
20					2	0 68			2	7 30	1	3 30	2	4 80	2	4 20	1⁵	3 60
21			—						2	7 30		3.30	2	4 80	2	4 20	2	4.80
22	4	0 24	¼	0.05	4	1.36	2	0 13	2	7.30		3 30	2	4 80	2	4 20	2	4 80
23									2	7.30		3.30	2	4.80	2	4 20	2	4.80
24			—			—			2	7.30		3.30	2	4 80	2	4 20	2	4.80
25	—				—				2	7.30		3 30	2	4 80	2	4 20	1	2 40
26							—		2	7 30	1	3.30	2	4 80	2	4 20	1	2 40
27					4	1 36			2	7.30		3.30	2	4 80	2	4 20	2	4.80
28									2	7 30	1	3.30	2	4.80	2	4 20	2	4.80
29					4	1 36			2	7.30	1	3 30	2	4.80	2	4 20	1⁵	3 60
30	4	0 24	¼	0 05			2	0 13	2	7.30	1	3.30	2	4 80	2	4 20	2	4 80
31	—				2	0 68			2	7.30	1	3.30	2	4 80	2	4 20	2	4.40
Jan.																		
1	—	—				—	—		2	7.30	1	3.30	2	4.80	2	4 20	2	4.80
2					3	1 02			2	7.30	1	3.30	2	4 80	2	4 20	2	4.80
3	2	0 12	¼	0 05	—		½	0 04	2	7.30	1	3.30	2	4.80	2	4 20	2	4.80
4					—				2	7 30	1	3.30	2	4 80	2	4 20	2	3.80
5									2	7.30	1	3 30	2	4 80	2	4 20	2	3.80
6									2	7 30	1	3 30	2	4 80	2	4 20	2	4 20
7									2	7 30	1	3 30	2	4 80	2	4 20	1	2 40
8					4	1.36			2	7.30	1	3 30	2	4 80	2	4 20	1	2.40
9					—				2	7.30	1	3.30	2	4 80	2	4 20	1	2.40
10		—			4	1.36			2	7.30		3 30	2	4.80	2	4 20	1	2.40
11			—	—	3	1 02	—		2	7.30		3.30	2	4 80	2	4 20	1	2,40
12									2	7.30		3.30	2	4.80	2	4 20	1	2.40
13	2	0 12	¼	0 05			½	0 04	2	7.30	1	3.30	2	4.80	2	4.20	1	2.40
14					3	1 02			2	7.30	1	3.30	2	4 80	2	4 20	1	2 40
15	—								1	3.30		3.30	2	4.80	2	4 30		2.40
16	5	0.30	¼	0.05	3	1 02	2	0 13	2	7.30	1	3.30	2	4.80	2	4 20	1	2.40
17					—				2	7 30		3 30	2	4.80	2	4 20	1	2 40
18					4	1.36			2	7.30		3 30	2	4.80	2	4.20	2	4.80
19							—		2	7.30	1	3 30	2	4.80	2	4 20	2	4.80
20					—				2	7 30		3.30	2	4.80	2	4 20	1	2 40
21	3	0.18	¼	0 05	4	1 36	1	0 06	2	7.30	1	3.30	2	4.80	2	4 20	2	4 80
22					—				2	7.30		3.30	2	4.80	2	4 20	2	4.80
23		—			4	1.36			2	7.30		3.30	2	4.80	2	4 20	2	4.80
24									2	7.30	1	3 30	2	4 80	2	4 20	1	2.40
25					4	1.36	—		2	7.30		3 30	2	4 80	2	4 20	2	4 80
26									2	7 30	1	3 30	2	4.80	2	4 20	2	4 80
27					2	0.68			2	7 30	1	3 30	2	4.80	2	4 20	2	4.80
28					—				2	7.30		3.30	2	4 80	2	4 20	2	4 80
29	—	—			5	1.70			2	7.30		3 30	2	4.80	2	4.20	2	4 80
30							—		2	7.30	1	3 30	2	4.80	2	4 20	2	4.80
31					4	1.36			2	7.30	1	3.30	2	4.80	2	4 20	2	4.80
Feb.																		
1	—	—	—		3	1 02	—		2	7 30	1	3 30	2	4.80	2	4 20	2	4.80
2			—				—		2	7 30	1	3 30	2	4 80	2	4 20	2	4 80
3			—		4	1.36			2	7.30	1	3.30	2	4 80	2	4 20	2	4 80
4					4	1 36			2	7.30	1	3.30	2	4.80	2	4 20	2	4.80
5	2	[illegible]	¼	0 05			½	0 04	2	7 30	1	3.30	2	4.80	2	4 20	2	4 80
6									2	7.30	1	3.30	2	4.80	2	4 20	2	4.80
7					3	1 02			2	7 30	1	3 30	2	4.80	2	4 20	2	4.80
8									2	7.30	1	3 30	2	4 80	2	4 20	2	4.80
9					3	1 02			2	7 30	1	3 30	2	4 80	2	4 20	2	4.80
10	3	0.18	¼	0.05	2	0.68	1	0.06	2	7.30	1	3.30	2	4.80	2	4 20	2	4.80

Date	Laborers on Hoist Days	Laborers on Hoist Amount	Coal for Boilers Tons	Coal for Boilers Amount	Signal Oil Pints	Signal Oil Amount	Black Oil Pints	Black Oil Amount	Tallow Lbs	Tallow Amount	Waste Lbs	Waste Amount	Coal Oil Pints	Coal Oil Amount	Totals for Each Day	Feet Sunk per day	Material	Water Pumps Hrs Run	Water Pumps No. of revolutions	Air Pumps No. of revolutions	Remarks
Nov.																					
23	—		—	—			16	0 20						—	110.80	4 70				—	Lowering caisson.
24					—		16	0 20							105 14	3.80		—			
25		—		—			16	0 20						—	80.03	2 60				—	Began concreting in a. m.
26																0 28					
27																0 32				—	
28				—					—							0.00				—	
29						—					—					0 00		—		—	
30												—				0 00					
Dec.																					
1	—	—	15	36.75					—		—				36 75	0 08					
2			15	36 75	—					—				—	36 75	0 00	—	—	—	—	
3																0 37					
4									8	0.50	1	0 07			[illegible]	1.15		10	38		
5		—	7	17.15	8	0.34	8	0 10			1	0 07			[illegible]	[illegible]	sand	13¾	35	16	
6			8	19 60			8	0.10	8	0 50		0 07			88.90	0 72				13	
7			—				8	0.10				0 07			54.86	0 80	"			18	
8			11	37.74	8	0 34	8	0.10	8	0 50	1	0 07			[illegible]	3.09	"	22	35	16	
9			11	37 40	8	0 34	8	0 0				0 07			[illegible]	0.73	"			27	
10			5⁷	19 38			4	0 05	8	0 50	1	0 07			75 13	0 48				[illegible]	
11			5⁸	20 06	8	0 34	8	0.10			1	0 07			[illegible]	0 07			—		
12			5⁷	19.37			8	0 08	8	0 50		0 07			[illegible]	2 78	"	17	35	30	
13			5⁷	19 38	8	0 34	8	0.10				0 07			[illegible]	3 33	"	14	33	21	
14			6	20.74			8	0.10			1	0 07			100.46	0 00	"			16	
15			5⁸	20 06			8	0 10			1	0 07			[illegible]	0.00	"			27	
16			6	20 74			8	0 10			1	0 07			88.89	0 01	"			25	
17			5⁸	19.04			8	0 10			1	0 07			70.37	0 45	"			26	
18			6¹	20.74			8	0 10			1	0 07			100.74	1 97	"			25	
19			6	20 74			4	0 05			1	[illegible]			[illegible]	0.00	"		—	23	
20			5⁸	20 06			8	0 10			1	[illegible]			[illegible]	0 02	"			[illegible]	
21			6	20.74	8	0 34	8	0 10	8	0.50	1	[illegible]			[illegible]	2 37	"	24	38	28	
22			5⁷	19.30			8	0 10			1	[illegible]			141 78	[illegible]	"	13	35	25	
23			6¹	20.74			8	0 10	8	0 50	1	0 07			91.34	1 56	"	8	35	25	
24		—	6	20.74			8	0 10			1	0 07			[illegible]	0 73	"	4⅔	35	26	
25			6	20.74			4	0 05			1	[illegible]			[illegible]	0 00	"			22	
26			6⁵	20 74			4	0 05			1	0 07			[illegible]	0.13	"	—		24	
27		—	5⁷	19.38	8	0 34	8	0 10	8	0 50	1	0 07			110 05	[illegible]	"	[illegible]	32	26	
28			6¹	20 74			8	0 10			1	0.07			138.93	[illegible]	"	17	33	36	
29			5⁷	19.38			4	0 05	8	0 50	1	0 07			[illegible]	[illegible]	"			26	
30			6¹	20.74	8	0 34	8	0 10	8	0 50	1	[illegible]			118.25	2 07	"	19	36	21	
31			5⁸	20.06			8	0.10			1	0 07			146.63	[illegible]		21	37	25	
Jan.																					
1			6¹	20.74			8	0 10	8	0.52	1	0 07			102.38	0 26	"	[illegible]	15	24	
2			5⁸	[illegible]	8	0.34	8	0 10			1	[illegible]	8	0 11	[illegible]	0 01	"			21	
3			6¹	20.74			8	0 10	4	0 35	1	0 07			[illegible]	0 05	"	[illegible]	36	23	
4			6	20.74			8	0 10	8	0 50	1	0 07			181.20	[illegible]	sand &	[illegible]	36	[illegible]	
5			6	20.74			8	0 10			1	0 07			[illegible]	[illegible]	hard	10¾	34	[illegible]	
6	8⁴	11 76	6	20.74	8	0.34	8	0 10			1	0 07			[illegible]	1 00	clay.			24	
7	9⁶	13.36	6	20.74			8	0 10			1	0 07			201 20	0 03	"			25	
8	12	20.40	5	19 33			8	0 10			1	[illegible]			204.24	0 07	"			23	
9	12	20.40	6	20.74			8	0 10			1	0 07			201.27	0 03	"			24	
10	12	20.40	5	19 38	8	0 34	8	0 10				0 07			192.73	0 09	"			19	
11	10	27.00	5⁷	19 72			8	0.10			1	[illegible]			[illegible]	[illegible]	"			14	
12	12	20.40	6¹	20.74			8	0 10			1	0 07			196.51	0 07	"			[illegible]	
13	12	20.40	6	20.74			8	0.10				0 07			[illegible]	0 12	"			13	
14	12	20 40	5⁸	19.72	8	0 34	8	[illegible]				0 07	8	[illegible]	[illegible]	0 00	"			14	
15	12	20.40	6	20.74			8	0 10			1	[illegible]			[illegible]	1 00	"			18	
16	12	20.40	5⁸	[illegible]			8	0 10			1	0 07			[illegible]	0 93	"			20	
17	9⁶	[illegible]	6	20 74			8	[illegible]			1	[illegible]			[illegible]	0 17	"			19	
18	10⁸	18.36	5	19 38			8	0 10			1	0 07			[illegible]	[illegible]	"			18	Pump men running clay hoist.
19	[illegible]	[illegible]	6	20 74				0 10			1	0 07			184.30	0 10	"			2	
20	13⁸	[illegible]	6⁵	20 74	8	0 34	8	0 10			1	0 07			[illegible]	0 12	"			18	
21	12	20.40	5⁷	19 38			8	0 10			1	0 07			238.82	[illegible]	"			21	
22	12	20 40	6¹	20.74			8	0 10			1	0 07			245 30	[illegible]	"			20	
23	12	20 40	5	19 38			8	0 12			1	0 07			252.80	0 10	"			20	
24	12	20.40	6¹	20.74	8	0.34	8	0 12			1	0 07			[illegible]	[illegible]	"			[illegible]	
25	12	20 40	5	19 38			8	0 12			1	0 07	8	0 11	256.23	0 53	"			20	
26	12	20.40	6	20 74			8	0 12			1	0 07			249.24	[illegible]	"			21	
27	10⁸	18 36	5⁸	20 06			8	0 12			1	0 07			254.67	1 17	"			21	
28	12	20 40	6¹	20.74	8	0 34	8	0 12			1	[illegible]			247.78	0 05	"			21	
29	12	20 40	5⁸	19 04			8	0 12	—		1	0 07			[illegible]	[illegible]	"			21	
30	12	20.40	6	20.40			8	0 12			1	0 07			262.34	0 58	"			20	
31	10⁸	18 36	5⁷	19 33			8	0 12			1	0 07			257.90	[illegible]	"			19	
Feb.																					
1	9⁶	16 32	5⁷	19.72	8	0.34	8	0 12			1	0 07	8	0 11	255.56	[illegible]	"			2	
2	10⁸	18.36	6¹	20 74			8	[illegible]			1	0 07			249.74	0 06	"			22	
3	12	20.40	5⁷	[illegible]			8	0 12				0 07			257.57	0 32				23	
4	12	20.40	5⁷	19.38			8	[illegible]			1	0 07			[illegible]	2 15	"			24	
5	12	20 40	6¹	20.74	8	0 34	8	[illegible]			1	0 07			[illegible]	0 09	"			23	
6	12	20 40	6¹	20.74	—		8	0 12				0 07			249.03	[illegible]	"			23	
7	13⁵	20.46	5⁸	19.72			8	[illegible]			1	0 07			[illegible]	[illegible]	"			23	
8	8⁴	[illegible]	6	20 74			8	[illegible]			1	0 07	16	[illegible]	244.92	1 25	"			24	
9	13⁴	[illegible]	5⁸	[illegible]	8	0.34	8	[illegible]			1	0 07			[illegible]	0 08	clay		—	24	
10	12	20.40	5⁸	20 06			8	0 12				0 07			253 85	1 16	coarse sand			24	

APPENDIX E. Continued.

PIER III. CONTINUED

Date 1887	Principal Foreman Days	Amount	Night Foreman Days	Amount	Sub Foremen Days	Amount	Lock Tenders Days	Amount	Pressure Men Days	Amount	Coffee house Men Days	Amount	Coffee Lbs	Amount	Sugar Lbs	Amount	Candles No.	Amount	Red Lead Lbs	Amount	Wick Lbs	Amount
Feb. 11	1	6.00	1	3.57	5^6	17.88	2	5.00	56^6	141.25	2	3.00	5	1.12	10	0.63	2	0.03				
12	1	6.00	1	3.57	6	19.50	2	5.00	61	152.50	2	3.00	4	0.90	5	0.32	—					
13	1	6.00	1	3.57	6	19.50	2	5.00	57^6	143.75	2	3.00	5	1.13	10	0.63	6	0.08				
14	1	6.00	1	3.58	5^6	17.87	2	5.00	53^6	133.75	2	3.00	4	0.90	5	0.32	2	0.02	2	0.12	¼	0.05
15	1	6.00	1	3.57	5	16.25	2	5.00	57	142.50	2	3.00	5	1.12	10	0.63	2	0.03		—		
16									—			—										
17	1	6.00	—	—	3	9.75	1	2.50	30^6	76.25	1	1.50	2	0.45	5	0.32						
18	1	6.00	1	3.57	6	19.50	2	5.00	54	135.00	2	3.00	5	1.13	10	0.63	3	0.04	—			
19	1	6.00	1	3.57	6	19.50	2	5.00	52^6	131.25	2	3.00	4	0.90	10	0.63	1	0.02				
20			1	3.57	3_6	9.75	1	2.50	24^6	61.25	1	1.50	3	0.68	5	0.32	—					
21		—				1.63	—	—	4	10.00		—			—							
22					—		—															
23	1	6.00			2^6	8.12	1	2.50	28^6	71.25		—	2	0.45	5	0.32	3	0.04				
24	1	6.00	1	3.57	6	19.50	2	5.00	62^6	156.25	2	3.00	4	0.90	5	0.32	—			—		
25	1	6.00	1	3.57	5^6	17.88	2	5.00	62	155.00	2	3.00	4	0.90	10	0.63	5	0.06				—
26	1	6.00	1	3.57	5	16.25	2	5.00	60^6	151.25	2	3.00	5	1.12	10	0.63	2	0.02		—		
27	1	6.00	1	3.57	5	16.25	2	5.00	64	160.00	2	3.00	4	0.90	5	0.32	2	0.03		—		
28	1	6.00	1	3.58	5	16.25	2	5.00	60	150.00	2	3.00	3	0.67	10	0.63	3	0.04	—			
Mar. 1	1	6.00	1	3.23	6	19.50	2	5.00	66^6	166.25	2	3.00	3	0.68	5	0.32	12	0.15				
2									—				1	0.23	5	0.32	7	0.09	—			
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10	1	6.00	1	3.23	4^6	14.62	1	2.50	45	112.50	2	3.00	4	0.90	6	0.39	2	0.02				
11	1	6.00	1	3.23	6	19.50	2	5.00	63	157.50	2	3.00	5	1.13	6	0.39	10	0.12	—			
12	1	6.00	1	3.23	6	19.50	2	5.00	58	145.00	2	3.00	3	0.67	4	0.25	3	0.04				
13	1	6.00	1	3.23	4^6	14.63	2	5.00	44^6	111.25	2	3.00	3	0.68	5	0.34	12	0.15	—	—		
14	1	6.00	1	3.23			1	2.50	[illegible]		2	3.00	5	1.12	7	0.50	2	0.03	—			
15	—																					
16	1	6.00	1	3.23	5	16.25	2	5.00	58^6	146.25	2	3.00	5	1.13	11	0.79	3	0.04				
17	1	6.00	1	3.23	6	19.50	2	5.00	60^6	151.25	2	3.00	5	1.13	7	0.50	9	0.11				
18	½	3.00	1	3.23	1^6	4.87	1^6	3.75	29	72.50	1½	2.25	—			—			—			
19																						
20																						
21																						
22																						
23																						
24																						
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31																						
Apr. 1																						
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
11																						
12	1	6.00			$1^?$	4.88	1	2.50	$17^?$	43.75	1	1.50	1	0.22	4	0.26	6	0.07	5	0.30	¼	0.05
13	1	6.00	1	3.33	6	19.50	2	5.00	58	145.00	2	3.00	2	0.45	4	0.26	11	0.14	—			
14	1	6.00	1	3.33	6	19.50	2	5.00	58	145.00	2	3.00	4	0.90	8	0.52	3	0.04				
15	1	6.00	1	3.34	6	19.50	2	5.00	60^6	151.25	2	3.00	3	0.67	8	0.52	12	0.15		—		
16	1	6.00	1	3.33	6	19.50	2	5.00	59	147.50	2	3.00	3	0.68	6	0.39	3	0.04				
17	1	6.00	1	3.33	6	19.50	2	5.00	55^6	138.75	2	3.00	3	0.60	10	0.65	12	0.15				
18	1	6.00	1	3.34	6	19.50	2	5.00	55	137.50	2	3.00	3	0.60	8	0.52	36	0.45				
19	1	6.00	1	3.33	6	19.50	2	5.00	54^6	136.25	2	3.00	3	0.60	6	0.39	20	0.25	—			
20	1	6.00	1	3.33	5^6	17.87	2	5.00	49	122.50	2	3.00	4	0.80	10	0.65	10	0.13				
21	1	6.00	1	3.34	5	16.25	2	5.00	46^6	116.25	2	3.00	2	0.40	4	0.26	4	0.05				
22	1	6.00	1	3.33	6	19.50	2	5.00	54^6	136.35	2	3.00	4	0.80	10	0.65	4	0.05	—			
23	1	6.00	1	3.33	7	22.75	2	5.00	63	150.75	2	3.00	2	0.40	8	0.52	6	0.08	—	—		
24	1	6.00	1	3.34	6	19.50	2	5.00	55^6	138.75	2	3.00	4	0.80	10	0.65	4	0.05				
25	1	6.00	1	3.33	6	19.50	2	5.00	56	140.00	2	3.00	4	0.80	8	0.52	9	0.11				
26	1	6.00	1	3.33	4	13.00	2	5.00	34	85.00	2	3.00	3	0.60	6	0.39	11	0.14	—	—		
27					—				—		—		—	—			—		—			
Totals		655.80		357.51		1446.83		505.25		11329.01		370.75		80.11		41.50		5.94		4.56		0.60

Date 1887	Cord for heating Boxes	Amount	Linseed Oil Pints	Amount	Day Engineers Days	Amount	Night Engineers Days	Amount	[illegible] Days	Amount	[illegible] Days	Amount	[illegible] Days	Amount	[illegible] Days	Amount	[illegible] Lbs	Amount
Feb. 11					2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	20.40	6	20.74
12					2	7.30	1	3.30	2	4.80	2	4.20	1^2	2.80	10^6	18.36	6	20.74
13	3	1.02			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	20.40	5^6	19.72
14	2	0.68	½	0.04	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	20.40	5^6	20.00
15	—	—			1	3.30	1	3.30	2	4.80	2	4.20	2	4.80	12	20.40	6	20.74
16																	$1^?$	4.60
17	—	—			2	7.30			1	2.40	1	2.10	1	2.40	6	10.20	6	20.74
18	1	0.34			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	10^1	17.17	6	20.40
19	—				2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	20.40	6	20.74
20	4	1.36					1	3.30	1	2.40	1	2.10	1	2.40	6	10.20	5^7	19.38
21	—				—													4.60
22									—									4.60
23	—				2	7.30			1	2.40	1	2.10	1	2.40	5^6	9.35	6^1	20.74
24	3	1.02			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12^6	20.52	5^7	19.72
25	2	0.68	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12^2	20.32	5^7	22.10
26	2	0.68			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	20.40	5^6	22.10
27	3	1.02			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	20.40	6^4	21.76
28	—		—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	20.40	6^7	22.78
Mar. 1	4	1.36			2^1	7.58	1^3	4.12	2^1	5.00	2^1	4.37	2	4.80	12^6	20.97	6^8	21.42
2	—		—		2	7.30	1	3.30	2	4.80	2	4.20			—		6^7	22.78
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10					2	7.30	1	3.30	2	4.80	2	4.20	1	2.00	6^2	10.33	6^7	22.78
11	—	—			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	6^6	11.56	6	22.78
12					2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	5^1	9.8	6^7	22.78
13					2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	5^6	9.14	6^7	22.78
14	1	0.34			2	7.30	1	3.30	2	4.80	2	4.20			2	3.40	6^6	22.44
15																		
16	4	1.36			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	5^4	9.18	6^8	21.42
17					2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	5^4	9.18	6^7	22.78
18	—				1	3.65	1	3.30	1^6	3.60	1^6	3.15	1	2.40	2^7	4.57	6	22.78
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		
27																		
28																		
29																		
30																		
31																		
Apr. 1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12	3	1.02	2	0.12	3	11.25			1	2.40	1	2.10	1	2.40			$6^?$	22.10
13	1	0.34			2	7.60	1	3.30	2	4.80	2	4.20	1	2.40	5^4	9.18	6^6	22.10
14	—		—		2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	5^4	9.18	6^7	22.78
15	3	1.02			2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	5^6	9.21	6^8	21.76
16	—				2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	5^6	9.21	6^7	22.78
17	—				2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	5^6	9.12	6^7	22.78
18					2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	$5^?$	9.34	$6^?$	22.78
19	3	1.02			2	7.60	1	3.30	2	4.80	2	4.20	2	4.80	$1^?$	2.40	6^4	21.76
20					2	7.60	1	3.30	2	4.80	2	4.20	1	2.40			6^7	22.78
21	—				2	7.60	1	3.30	2	4.80	2	4.20	1	2.40			6	22.78
22	4	1.36			2	7.60	1	3.30	2	4.80	2	4.20	1	2.40			6^8	21.42
23					2	7.60	1	3.30	2	4.80	2	4.20			—		$6^?$	22.78
24			—		2	7.60	1	3.30	2	4.80	2	4.20	—				6	22.78
25	4	1.36			2	7.60	1	3.30	2	4.80	2	4.20	1	2.40	—	—	6^8	21.42
26	—		—		2	7.60	1^6	4.95	2	4.80	2	4.20					6^7	22.78
27	—						—				—					—		
Totals		51.00		1.86		768.48		350.67		513.40		447.13		424.80		1120.41		2343.23

Date 1887	Signal Oil Pints	Amount	Black Oil Pints	Amount	Tallow Lbs	Amount	Waste Lbs	Amount	Coal Oil Pints	Amount	Totals for Each Day	Feet Sunk per day	Material	Water Pumps Hours run	No. of revolutions	Air Pumps No. of revolutions	REMARKS
Feb. 11			8	0.12			1	0.07			244.21	0.0	Sand and gravel			27	
12			8	0.12			1	0.07		—	252.48	0.00				24	
13	8	0.34	8	0.12			1	0.07	—		248.73	1.11	"			26	
14			8	0.12			1	0.07			236.38	0.19	"			25	
15			8	0.12			1	0.07			239.83	1.30	"			21	
16			8	[illegible]	—		1	0.07			4.79	0.00	"				Working in Pier II
17	8	0.34	8	0.12			1	0.07	—		142.44	0.05	"			25	
18	—		8	0.12	—		1	0.07			233.37	0.04	"			25	
19			8	0.12				0.07			235.00	0.00	"			26	
20			8	0.12			1	0.07			170.90	1.23	"			24	Working in Pier II
21	—			—							16.23	0.00	"			—	" "
22							—				4.60	0.00	"				
23	8	0.34	8	0.12			1	0.07	—		133.50	0.00	"			23	
24	—		8	0.12	—		1	0.07			260.39	1.33	"			26	
25	—		8	0.12				0.07			259.73	0.15	"			25	
26	8	0.34	8	0.12	—			0.07			254.93	0.59	"			25	
27	—		8	0.12	—		1	0.07			262.84	0.36	"			26	
28			8	0.12	—		1	0.07	—		252.74	0.24	clay	—		26	
Mar. 1			8	0.12			1	0.07	—		273.94	0.50	"	—	—	24	Work suspended. River breaking up
2	—	—		—				—	—		43.02	0.01	"			21	"
3																	" "
4																	" "
5																	" "
6																	" "
7																	" "
8																	" "
9																	" "
10	8	0.34	—						—		158.21	0.02	clay	—		21	
11			8	0.12	—		1	0.07			254.80	0.25	"			23	
12			8	0.12			1	0.07			239.34		"			23	
13			8	0.12				0.07			200.79		"			20	
14	8	0.34	4	0.06	—		1	0.07			62.63		"			13	
15	—		—						—				—				
16			8	0.12				0.07			238.24	0.07	"		—	23	
17			8	0.12	—		1	0.07			246.26		"			34	
18			4	0.06	—			0.07	—		133.20		"	—		33	Working in Pier II
19																	" "
20																	" "
21																	" "
22																	" "
23																	" "
24																	" "
25																	" "
26																	" "
27																	" "
28																	" "
29																	" "
30																	" "
31																	" "
Apr. 1																	" "
2																	" "
3																	" "
4																	" "
5																	" "
6																	" "
7																	" "
8																	" "
9																	" "
10																	" "
11																	" "
12			4	0.06	—		1	0.07			101.05		clay			22	
13	—		8	0.12				0.07			236.79		"	—		25	
14	8	0.34	8	0.12			1	0.07			240.48	0.01				23	
15			8	0.12			1	0.07	8	0.11	246.42	0.00	"			24	
16	—		8	0.12	—		1	0.07		—	242.32	0.13	"			22	
17			8	0.12			1	0.07			233.77	0.52	"			20	
18	8	0.34	8	0.12			1	0.07	—		233.16	0.38	"			19	
19	—		8	0.12	—		1	0.07	8	0.11	224.50					17	Began sealing caisson
20			8	0.12			1	0.07			204.33		"			18	
21			8	0.12	—	—	1	0.07	—		[illegible]		"			19	
22	8	0.34	8	[illegible]			1	0.07			220.19		"			17	
23	—		8	0.12			1	0.07	—		242.70		"			14	
24			8	0.12	—		1	0.07	—		219.96		"			[illegible]	
25			8	0.12	—			0.07			223.53		"			16	
26	8	0.34	4	0.06			1	0.07	8	0.1[illegible]	161.37		"				
27				—							—	0.04					Took off air at 8 a.m.
Totals		9.57		11.97		6.29		7.56		0.99	20825.12						

Other expenses charged to sinking . $1633.86

$22458.98

APPENDIX E.—Continued.

TIME, COST AND MATERIALS USED IN FOUNDATIONS. PIER IV.

Date 1886	Principal Foreman Days	Principal Foreman Amount	Night Foreman Days	Night Foreman Amount	Sub Foremen Days	Sub Foremen Amount	Lock Tenders Days	Lock Tenders Amount	Pressure Men Days	Pressure Men Amount	Coffee house Men Days	Coffee house Men Amount	Coffee Lbs	Coffee Amount	Sugar Lbs	Sugar Amount	Candles No	Candles Amount	Red Lead Lbs	Red Lead Amount	Wick Lbs	Wick Amount	Coal for heating, 200 lbs. Boxes	Coal for heating Amount
Aug																								
22	1	6.00	1	3.23	3	9.00	1	2.25	32^6	73.12	2	3.25		0.28	3¼	0.20	13	0.16	40	2.40		—		
23	1	6.00	1	3.23	3	9.00	2	4.50	32	77.00	2	3.25	4	0.56	5	0.31	4	0.05			—			
24	1	6.00	1	3.23	3	9.00	2	4.50	29	65.75	2	3.25	4	0.56	5	0.31							2	0.63
25	1	6.00	1	3.23	3	9.00	2	4.50	31^5	70.88	2	3.25	3	0.42	4	0.25	6	0.07	—	—	—			
26	1	6.00	1	3.23	3	9.00	2	4.50	34	76.50	2	3.25	4	0.56	5	0.31	6	0.08		—				
27	1	6.00	1	3.23	3	9.00	2	4.50	34	76.50	2	3.25	3	0.42	5	0.31	3	0.04	—	—	—			
28	1	6.00	1	3.23	3	9.00	2	4.50	34	76.50	2	3.25	6	0.84	8	0.50	8	0.10		—			2	0.63
29	1	6.00	1	3.23	3	9.00	2	4.50	33^6	75.37	2	3.25	3	0.42	3½	0.22	6	0.07	—			—		
30	1	6.00	1	3.23	3	9.00	2	4.50	36	81.00	2	3.25	3	0.42	8	0.50	3	0.04	—	—	—		2	0.63
31	1	6.00	1	3.23	2	6.00	2	4.20	33^5	75.38	2	3.25	4	0.56	4	0.25	4	0.05	—					—
Sept																								
1	1	6.00	1	3.33	3	9.00	2	4.50	34^4	77.62	2	3.25	3	0.42	7	0.44	12	0.15	—		—	—	3	0.94
2	1	6.00	1	3.33	3	9.00	2	4.50	34^6	77.63	2	3.25	3	0.42	4	0.25	4	0.05	5	0.30	½	0.09	—	
3	1	6.00	1	3.34	1	3.00	2	4.50	11	25.87	2	3.25	1	0.14	4	0.25	3	0.04	—				—	
4	1	6.00	1	3.33	—		2	4.50		—	2	3.25	2	0.28	4	0.25	8	0.10	5	0.30	½	0.10		
5	1	6.00	1	3.33	2	6.00	2	4.50	24	54.00	2	3.25	3	0.42	3	0.19	10	0.12	—				3	0.95
6	1	6.00	1	3.34	3	9.00	2	4.50	33	74.25	2	3.25	3	0.42	8	0.50							—	
7	1	6.00	1	3.33	3	9.50	2	4.75	34	85.00	2	3.25	3	0.42	4	0.25	13	0.16	5	0.30	½	0.09		
8	1	6.00	1	3.33	4	13.00	2	5.00	39	98.76	2	3.25	4	0.56	4	0.25	3	0.04						1.63
9	1	6.00		3.34	4	13.00	2	5.00	40	100.00	2	3.25	4	0.56	8	0.50	2	0.02	—	—			—	
10	1	6.00	1	3.33	4	13.00	2	5.00	36	90.00	2	3.25	3	0.42	4	0.25	6	0.08	5	0.30	¼	0.05		
11	1	6.00	1	3.33	4	13.00	2	5.00	38^5	96.25	2	3.25	3	0.42	4	0.25	6	0.07					3	0.94
12	1	6.00	1	3.34	4	13.00	2	5.00	41	103.75	2	3.25	3	0.42	8½	0.53							—	
13	1	6.00	1	3.33	4	13.00	2	5.00	42	105.00	2	3.25	2	0.28	4	0.25	8	0.10	—				—	
14	1	6.00	1	3.33	4	13.00	2	5.00	40	100.00	2	3.25	4	0.56	4	0.25	6	0.06	—	—			3	0.95
15	1	6.00	1	3.34	4	13.00	2	5.00	43	107.50	1	1.75	5	0.70	2½	0.16	6	0.07					—	
16	1	6.00	1	3.33	4	13.00	2	5.00	41	102.50	1	1.75	4	0.56	9	0.56	3	0.04	—	—	—		1	0.31
17	1	6.00	1	3.33	3	9.75	2	5.00	40	101.25	2	3.25	5	0.70	9	0.56	4	0.05					3	0.95
18	1	6.00		3.34	4	13.00	2	5.00	36	90.00	2	3.25	4	0.56	4	0.25	6	0.08	—	—	—			
19	1	6.00	1	3.33	3	9.75	2	5.00	37	92.50	2	3.25	3	0.42	3	0.19								
20	1	6.00	1	3.33	4	13.00	2	5.00	41	102.50	2	3.25	3	0.44	4	0.25	14	0.17	—				3	0.94
21	1	6.00	1	3.34	4	13.00	2	5.00	40	100.00	2	3.25	3	0.50	7	0.44	3	0.04				—		
22	1	6.00	1	3.33	4	13.06	2	5.00	40	100.00	2	3.25	3	0.49	4	0.25					—		3	0.95
23	1	6.00	1	3.33	4	13.00	2	5.00	38	95.00	2	3.25	3	0.50	4	0.25	5	0.06				—		
24	1	6.00	1	3.34	4	13.00	2	00	41	102.50	2	3.25	3	0.49	8	0.50	6	0.08	—		—			
25	1	6.00	1	3.33	4	13.00	2	5.00	40^6	101.25	2	3.25	3	0.50	4	0.25	6	0.07					2	0.63
26	1	6.00	1	3.33	4	13.00	2	5.00	40	100.00	2	3.25	3	0.49	4	0.25	6	0.08	32	0.21	¼	0.05	—	
27	1	6.00	1	3.34	5	16.25	2	5.00	41	102.50	2	3.00	3	0.50	8	0.50	19	0.24		—		—	3	0.94
28	1	6.00	1	3.33	5½	17.87	2	5.00	53	132.50	2	3.00	4	0.66	8	0.50	2	0.02	—	—			—	
29	1	6.00	1	3.33	5½	17.88	2	5.00	60	150.00	2	3.00	4	0.66	4	0.25	6	0.07		—		—	3	1.95
30	1	6.00	1	3.34	6	19.50	2	5.00	60	150.00	2	3.00	4	0.66	4	0.25	10	0.13	—	—			—	
Oct.																								
1	1	6.00	1	3.23	6	19.50	2	5.00	56^5	141.25	2	3.00	4	0.66	8	0.50	6	0.07	5	0.30	½	0.09	3	0.94
2	1	6.00	1	3.23	6	19.50	2	5.00	55	137.50	2	3.00	6	0.99	8	0.50	10	0.13					3	0.95
3	1	00	1	3.23	6	19.50	2	5.00	58^5	146.25	2	3.00	6	0.99	8	0.50		-			-	-	-	
4	1	6.00	1	3.23	6	19.50	2	5.00	59	147.50	2	3.00	5	0.82	8	0.50	5	0.06	—				3	0.94
5	1	6.00	1	3.23	6	19.50	2	5.00	58	145.00	2	3.00	5	0.83	8	0.50	5	0.07		—	—	—		
6	1	6.00	1	3.23	6	19.50	2	5.00	63	157.50	2	3.00	6	0.99	4	0.25	10	0.13			—		3	0.95
7	1	6.00	1	3.23	6	19.50	2	5.00	63^5	158.75	2	3.00	6	0.99	8	0.50				—		—	—	
8	1	6.00	1	3.23	6	19.50	2	5.00	57	143.75	2	3.00	4	0.66	8	0.50	7	0.09			—		3	0.94
9	1	6.00	1	3.23	4	13.00	2	5.00	61	152.50	2	3.00	6	0.99	8	0.50	1	0.01	—				—	
10	1	6.00	1	3.23	6	19.50	2	5.00	65	162.50	2	3.00	6	0.99	8	0.50	7	0.09			—		3	0.95
11	1	6.00	1	3.23	6	19.50	2	5.00	63	157.50	2	3.00	6	0.99	8	0.50	18	0.23					—	
12	1	6.00	1	3.23	6	19.50	2	5.00	61	152.50	2	3.00	5	0.82	8	0.50	9	0.11	5	0.30	½	0.10	3	0.94
13	1	6.00	1	3.23	6	19.50	2	5.00	57^5	143.75	2	3.00	6	1.00	8	0.50	3	0.04	—		—		—	
14	1	6.00	1	3.23	6	19.50	2	5.00	60	151.25	2	3.00	6	1.00	8	0.50	9	0.12		—		—	3	0.95
15	1	6.00	1	3.23	6	19.50	2	5.00	55^5	138.75	2	3.00	5	0.84	2½	0.16	6	0.07	—	—	—			
16	1	6.00	1	3.23	5	16.25	2	5.00	55^5	138.75	2	3.00	4	0.67	9	0.56	3	0.04		—	—		3	0.94
17	1	6.00	1	3.23	5^5	17.87	2	5.00	55	137.50	2	3.00	5	0.84	9	0.56	4	0.05			—			
18	1	6.00	1	3.23	6	19.50	2	5.00	53^5	133.75	2	3.00	4	0.67	4	0.25	6	0.08					—	
19	1	6.00	1	3.22	6	19.50	2	5.00	53	133.75	2	3.00	3	0.50	3	0.19			—		—		3	0.95
20	1	6.00	1	3.22	6	19.50	2	5.00	55	137.50	2	3.00	3	0.50	4	0.25	14	0.17			—		—	
21	1	6.00	1	3.22	5	16.25	2	5.00	53^5	133.75	2	3.00	3	0.50	7	0.44	3	0.04	—		—		3	0.94
22	1	6.00	1	3.22	6	19.50	2	5.00	43^5	108.75	2	3.00	3	0.51	4	0.25							—	—
23	1	6.00	1	3.22	6	19.50	2	5.00	30^5	76.25	2	3.00	3	0.50	4	0.26	5	0.06	—		—		3	0.95
24	1	6.00	1	3.22	6	19.50	2	5.00	45	113.75	2	3.00	3	0.50	8	0.51	6	0.07		—	—	—	—	—
25	1	6.00	1	3.22	6	19.50	2	5.00	59	148.75	2	3.00	3	0.50	4	0.25	6	0.08		—			3	0.94
26	1	6.00	1	3.22	5	16.25	2	5.00	57	142.50	2	3.00	3	0.51	4	0.25	6	0.07	—	—		—		
27	1	6.00	1	3.22	5	16.25	2	5.00	49^5	123.75	2	3.00	3	0.50	8	0.51	19	0.25			—		3	0.95
28	1	6.00	1	3.22	5	16.25	2	5.00	55	137.50	2	3.00	4	0.67	8	0.51	2	0.02	—				3	0.94
29	1	6.00	1	3.22	6	19.50	2	5.00	58	145.00	2	3.00	4	0.67	4	0.26	6	0.08			—	—	3	0.95
30	1	6.00	1	3.22	6	19.50	2	5.00	58	145.00	2	3.00	4	0.67	4	0.25	10	0.12	—				—	
31	1	6.00	1	3.22	6	19.50	2	5.00	55^5	138.75	2	3.00	4	0.67	8	0.51	6	0.08	—				—	
Nov																								
1	1	6.00	1	3.33	6	19.50	2	5.00	56	140.00	2	3.00	4	0.67	8	0.51	6	0.07	—		—		3	0.94
2	1	6.00	1	3.33	5^5	17.88	2	5.00	53^5	133.75	2	3.00	6	1.00	8	0.51	10	0.13	—					
3	1	6.00	1	3.34	5	16.25	2	5.00	54^5	136.25	2	3.00	6	1.00	8	0.51					—		—	
4	1	6.00	1	3.33	6	19.50	2	5.00	54	136.25	2	3.00	5	0.84	8	0.51	5	0.06	—		—		3	0.95
5	1	6.00	1	3.33	4^5	14.62	2	5.00	56^5	141.25	2	3.00	5	0.84	8	0.51	5	0.07						
6	1	6.00		3.34	6	19.50	2	5.00	56^5	141.25	2	3.00	6	1.00	4	0.26	10	0.12	—	—	—		3	0.94
7	1	6.00	1	3.33	5	16.25	2	5.00	54^5	136.25	2	3.00	6	1.00	8	0.51	—	—	—		—		3	0.95
8	1	6.00	1	3.33	6	19.50	2	5.00	52^5	131.25	2	3.00	4	0.67	8	0.51	7	0.09						
9	1	6.00	1	3.34	3	9.75	2	4.25	13	32.50	2	3.00	6	1.00	8	0.51	1	0.01		—	—		—	
		480.00		262.30		1177.37		388.75		9018.13		246.00		50.57		30.04		5.85		4.41		0.57		30.87

Date 1886	Linseed Pints	Linseed Amount	Day Engineers Days	Day Engineers Amount	Night Engineer Days	Night Engineer Amount	Firemen Days	Firemen Amount	Coal Passers Days	Coal Passers Amount	L[illegible] Men Days	L[illegible] Men Amount	Laborers on [illegible] Days	Laborers Amount	Coal for Boilers Tons	Coal for Boilers Amount	Signal Oil Pints	Signal Oil Amount	Black Oil Pints	Black Oil Amount	Tallow Lbs	Tallow Amount	Waste Lbs	Waste Amount	Coal Oil Pints	Coal Oil Amount
Aug																										
22	16	1.00	2	7.30		3.30	1	2.40	1	2.10	1	2.40			3^5	11.90	8	0.34	2	0.17			1	0.07	—	
23			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			3	10.20	—		8	0.11	10	0.65	1	0.07	—	
24	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			6^5	22.10			8	0.11			1	0.07		
25			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			7	23.80	—		8	0.11	10	0.65	1	0.07		
26			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			7	23.80	8	0.34	8	0.11			1	0.07	8	0.11
27	—	—	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			7^5	25.50	—		8	0.11	10	0.63	1	0.07	—	
28			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			7^3	24.82			8	0.11	—		1	0.07		
29	—	—	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			7	23.80	—		8	0.11	10	0.63	1	0.07	—	—
30			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			7	23.80	8	0.34	8	0.11	—		1	0.07		
31	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	—	—	7	23.80	—		8	0.11	10	0.63	1	0.07	—	—
Sept																										
1	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			6^2	21.08			8	0.11	—	—	1	0.07		
2	2	0.12	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			2^3	7.82	—		8	0.11	10	0.64	1	0.07	—	
3			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			2	6.80	8	0.34	8	0.11	—		1	0.07		
4	2	0.13	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			6^5	22.10			8	0.11	10	0.64	1	0.07		
5	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80		—	7^5	25.50			8	0.11			1	0.07		
6			2	7.30	1	3.30	2	4.80	1	2.10	2	4.80			7^7	26.18			8	0.11	10	0.63	1	0.07		
7	2	0.12	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			7^8	26.52	8	0.34	8	0.11	—		1	0.07	—	
8			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			4^6	15.64	—		8	0.10	10	0.63	1	0.07	—	
9	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			4^5	15.30			8	0.10			1	0.07	—	
10	2	0.13	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80			3^9	13.26	—		8	0.10	10	0.63	1	0.07	8	0.11
11	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	8^4	11.76	2^2	7.48	8	0.34	8	0.10			1	0.07	—	
12			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	10^6	14.84	2^7	9.18	—		8	0.10	—		1	0.07	—	—
13	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	9^6	13.44	2^7	9.18	—		8	0.10	—		1	0.07		
14			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	9^6	13.44	3	10.20			8	0.10	—		1	0.07	—	
15	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	9^6	13.44	3	10.20	8	0.34	8	0.10	—		1	0.07		
16			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	9^6	13.44	3^1	10.54	—		8	0.10	—		1	0.07		
17	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	9^6	13.44	3^4	11.56			8	0.10	—		1	0.07	—	—
18			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	9^6	13.44	3^8	12.92	—		8	0.10	—	—	1	0.07	—	
19	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	9^6	13.44	4	9.80	8	0.34	8	0.10	—		1	0.07	—	
20			2	7.30	1	3.85	2	4.80	2	4.20	2	4.80	9^6	13.44	4	9.80	—		8	0.10	—		1	0.07	—	
21	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	10^8	15.12	3^9	13.26	—		8	0.10			1	0.07		
22	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	9^6	13.44	2^7	9.18	—		8	0.10			1	0.07	—	
23	—	—	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12^8	17.92	3^5	11.90	8	0.34	8	0.10	—		1	0.07		
24			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3^4	11.56	—		8	0.10	—		1	0.07	—	
25	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3^5	11.90	—	—	8	0.10	—		1	0.07	—	
26	2	0.12	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3	10.20			8	0.10			1	0.07		
27			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3	10.20	8	0.34	8	0.10	—		1	0.07		
28	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	4	13.60	8	0.34	8	0.10	—		1	0.07		
29			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	4	13.60	—	—	8	0.10	—	—	1	0.07	—	
30			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3	10.20			8	0.10			1	0.07		
Oct.																										
1	3	0.19	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3^6	12.24	8	0.34	8	0.10	—		1	0.07		
2			2	7.50	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3^6	12.24			8	0.10	—		1	0.07	—	—
3	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3^1	10.54	8	0.34	8	0.10	—		1	0.07		
4	—	—	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3^1	10.54			8	0.10	—		1	0.07	—	
5	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3^2	10.88	—		8	0.10			1	0.07		
6	—	—	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3^6	12.24			8	0.10	—		1	0.07	—	
7	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	4	13.60	8	0.34	8	0.10	—	—	1	0.07		
8	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	4^1	13.94			8	0.10			1	0.07	—	
9	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	4^5	15.30	16	0.68	8	0.10	—		1	0.07	—	
10	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	[illegible]	6.66	6^4	21.76			8	0.10	—		1	0.07	—	
11	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	[illegible]	[illegible]	5^4	18.36	—		8	0.10			1	0.07	—	—
12	3	0.19	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	6	8.40	5^4	18.36			8	0.10			1	0.07		
13	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	4	13.60	8	0.34	8	0.10	—		1	0.07	—	
14	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	11^7	16.38	3^8	12.92	—	—	8	0.10	—		1	0.07		
15			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	11^6	16.24	4^5	15.30	—		8	0.10			1	0.07		
16			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3^7	12.58			8	0.10			1	0.07		
17			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	4^1	13.94	8	0.34	8	0.10	—		1	0.07	—	
18	—	—	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3^1	10.54	—		8	0.10			1	0.07		
19	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	8^7	12.18	3^6	12.24	8	0.34	8	0.10	—		1	0.07		
20	—	—	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	7^2	10.08	2^9	9.86	—		8	0.10			1	0.07	—	
21	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	15^6	21.84	2	6.80	8	0.34	8	0.10		—	1	0.07		
22	—		2	7.30	1	3.30	2	4.80	2	4.20	1	2.40	3^6	5.04	1^8	6.12	8	0.34	8	0.10		—	1	0.07	—	—
23			2	7.30	1	3.30	2	4.80	2	4.20			7	9.80	4^2	14.28			8	0.10	—		1	0.07		
24	—	—	2	7.30	1	3.30	2	4.80	2	4.20	1	2.40	7^2	10.08	4^5	15.30			8	0.10			1	0.07	—	
25	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	15	21.04	4^5	15.30	—		8	0.10			1	0.07		
26			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	15^6	21.84	4^8	16.32	8	0.34	8	0.10	—		1	0.07		
27	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	13^2	18.48	4	13.60			8	0.10	—	—	1	0.07		
28	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	12	16.80	3^3	11.30			8	0.10			1	0.07		
29	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	10^2	14.28	3^8	12.92	8	0.34	8	0.10	—	—	1	0.07	—	
30	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	10^2	14.28	3^6	12.24	—	—	8	0.10	—	—	1	0.07		
31	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	10^8	15.12	3^6	12.24	8	0.34	8	0.10	—	—	1	0.07	—	—
Nov																										
1	—		2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	10^2	14.28	3^3	11.22	—	—	8	0.10	—		1	0.07		
2			2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	8^4	11.76	3^1	10.54	—	—	8	0.10	—		1	0.07		
3	—		2	7.30	1	3.30	2	4.80	2	4.30	2	4.80	9^6	13.44	3^2	10.88	8	0.34	8	0.10			1	0.07		
4	—	—	2	7.30	1	3.30	2	4.80	2	4.20	2	4.80	10^2	14.28	4^1	13.94			8	0.10	—	—	1	0.07		
5			2	7.30	1	3.30	2	4.80	2	4.20	1	2.40	3^2	4.48	3^9	13.26	—		8	0.10			1	0.07	—	
6			2	7.30	1	3.30	2	4.80	2	4.20	—				3^8	12.92	8	0.34	8	0.10			1	0.07		
7			1	3.30	1	3.30	2	4.80	2	4.20				—	2^7	9.18	—		8	0.10	—	—	1	0.07		
8	—	—	2	7.30	1	3.30	2	4.80	2	4.20		—		—	0^4	[illegible]72	—	—	8	0.10			1	0.07		
9	—		2	7.30	1	3.30	2	4.80	2	4.20				—	—		—	—				—	—			
		2.00		580.00		264.00		381.60		331.80		348.00		824.88		1102.84		8.84		8.13		6.36		5.53		0.22

Date 1886	Totals for each day	Feet sunk per day	Material	Cameron Pumps Hours run	Cameron Pumps No. of revolutions	Air Pumps No. of revolutions	Remarks.
Aug							
22	130.87		gumbo	20 [illegible]	32	30	Started air pumps at 7.05 a. m.
23	134.33	1.15	"	23¾	33	24	Started Cameron pumps at 7 30 a. m.
24	137.91	1.51	"	23 5	37	23	
25	146.63	1.48	"	22 6	41	20	
26	152.26	1.77	"	23 10	40	18	
27	153.96	0.17	"	21¾	38	16	
28	153.95	3.21	"	23¼	40	13	
29	151.07	0.32	"	23	41	14	
30	157.29	2.34	"	24	39	10	
31	148.23	2.79	"	22 12	37	13	
Sept							
1	151.31	6.31	sand	24	39	16	
2	137.98	4.25	"	19⅔	39	15	
3	78.11	0.02	"	1	35	14	
4	63.16	0.00	"		—	10	
5	138.84	7.29	"	23½	39	20	
6	150.55	4.92	"	23½	41	21	
7	161.61	2.78	"	21¾	40	21	
8	171.66	2.46	"	23	41	19	
9	171.54	1.09	"	6 3	43	20	
10	160.38	0.20	clay	5 8	43	14	
11	172.66	0.35	"	23 12	37	21	Pump men running clay hoist.
12	183.88	0.41	"		—	24	
13	183.40	1.06	"			25	
14	180.63	0.00	"	—	—	28	
15	186.07	1.39	"			28	
16	181.60	0.00	"		—	31	
17	180.41	1.24	"	—		27	
18	172.41	0.11	"	—	—	32	
19	168.59	0.17	"	—		29	
20	182.69	1.12	"		—	32	
21	184.52	0.01	"	—		35	
22	179.46	1.76	"		—	34	
23	181.12	0.03	"	—		22	
24	187.09	0.03	"		—	31	
25	186.55	0.00	"	—		39	
26	183.35	1.47	"		—	35	
27	190.18	0.00	"	—		35	
28	224.19	1.78	"			30	
29	242.11	0.02	"		—	31	
30	239.45	0.01	"			29	
Oct.							
1	234.68	1.32	"			25	
2	230.41	0.01	"		—	33	
3	236.72	0.02	"	—		36	
4	238.46	1.65	"		—	34	
5	235.38	0.03	"	—		37	
6	250.16	1.79	"		—	27	
7	252.28	0.03	"	-		25	
8	237.98	1.71	"		—	30	
9	241.58	0.01	"			29	
10	264.75	1.22	"	—	-	25	
11	239.58	1.97	gravel			26	
12	243.52	0.05	"			25	
13	237.33	1.98	"		-	27	
14	244.42	0.01	"			27	
15	232.66	2.12	"		—	27	
16	228.39	0.00	"			29	
17	229.70	0.01	"		—	31	
18	223.39	2.14	"			30	
19	221.44	0.00	"	—	—	31	
20	219.65	0.01	"			31	
21	221.69	1.27	"	—	—	26	
22	179.90	0.05	"			16	
23	158.59	0.01	"	—	—	18	
24	199.10	0.00	"			28	
25	246.95	0.53	"	—	—	34	
26	239.87	1.55	"			33	
27	216.08	0.01	"		-	33	
28	226.38	0.78	"			28	
29	235.79	0.08	clay	-	-	29	
30	233.85	0.34	"			31	
31	229.00	0.21	"		—	32	
Nov							
1	229.09	0.64	"		—	32	
2	217.47	0.01	"			30	
3	220.56	0.12	"			30	
4	225.23	0.93	"			33	
5	214.53		"			30	Began filling caisson at 11:25 a. m.
6	213.44		"			29	
7	197.24		"	—		29	
8	191.84	0.04	"			24	
9	79.96		"				Took off air at 7:20 a. m.
	15559.06						

Other expenses charged to sinking $1595.93

$17154.99

APPENDIX F.

SPECIFICATIONS FOR SUPERSTRUCTURE

GENERAL DESCRIPTION

The superstructure will consist of three main through spans and six deck spans three of which will be at each end of the structure.

Each through span will be 375 feet long between centers of end pins, divided into fifteen panels of 25 feet each. The trusses will be 50 feet deep and placed 22 feet apart between centers. The top chord, end posts, bolsters, rollers, bearing plates, pins and all eye-bars except counters and vertical suspenders, will be of steel; all other parts will be of wrought iron except the wall plate pedestals and ornamental work, which will be cast. Each span will contain approximately 486,000 pounds of steel, 484,000 pounds of wrought iron and 21,000 pounds of cast iron.

Each deck span will be 125 feet long between centers of end pins, divided into five panels of 25 feet each. The trusses will be 17 feet 6 inches deep and placed 12 feet apart between centers. The intermediate ends of each set of three spans will rest on iron towers measuring 25 feet long in the direction of the bridge, making a total length of iron work in each group of three deck spans of 425 feet. The pins, rollers, bearing plates and eye-bars, excepting counters, will be of steel; all other parts will be of wrought iron except the wall plate pedestals, which will be of cast iron. Each span will contain approximately 102,000 pounds of wrought iron and 31,000 pounds of steel. Each group of three spans including the towers will contain approximately 93,000 pounds of steel, 398,000 pounds of wrought iron and 16,000 pounds of cast iron.

The total estimated weight of the entire structure is approximately 4,000,000 pounds.

PLANS

Full detail plans, showing all dimensions, will be furnished by the engineer. The work shall be built in all respects according to these plans. The contractor, however, will be expected to verify the correctness of the plans, and will be required to make any changes in the work which are necessitated by errors in these plans, without extra charge, where such errors could be discovered by an inspection of the plans.

MATERIALS

All materials shall be subject to inspection at all times during their manufacture, and the engineer and his inspectors shall be allowed free access to any of the works in which any portion of the material is made. Timely notice shall be given to the engineer so that his inspectors may be on hand.

Steel. The Steel used will be of two classes, viz.: High Steel, which will be used in compression members, bolsters, bearing plates, pins and rollers, and Low Steel, which will be used for tension members and rivets.

Steel may be made by the open hearth or by the Bessemer process, but no steel shall be made at works which have not been in successful operation for at least one year; steel made by the Clapp Griffiths process will not be accepted. All melts shall be made from uniform stock low in phosphorus, and the manufacturer shall furnish satisfactory evidence to the engineer that this class of material is being employed, it being understood that the furnished product is to be one in which the phosphorus does not average more than 8 100 of one per cent., and never exceeds 1 10 of one per cent.

A sample bar ¾ of an inch in diameter shall be rolled from every melt, the method of obtaining the piece from which this sample bar is rolled shall be the same for all samples, and the amount of work on this sample bar shall be as nearly as practicable the same as on the finished product. The laboratory tests shall be made on this sample bar in its natural state without annealing.

The laboratory test of High Steel made on the sample bar shall show an elastic limit of not less than 50,000 pounds per square inch, an ultimate strength of not less than 80,000 pounds nor more than 90,000 pounds, an elongation of at least 15 per cent in eight inches and a reduced area of at least 35 per cent. at the point of fracture. The sample bars shall bend 180° around its own diameter without showing crack or flaw.

The laboratory tests of Low Steel made on the sample bar shall show an elastic limit of not less than 40,000 pounds per square inch, an ultimate strength of not less than 70,000 pounds nor more than 80,000 pounds, an elongation of at least 18 per cent. in a length of eight inches, and a reduction of at least 42 per cent. at the point of fracture. In a bending test the sample bar shall bend 180° and close back against itself without showing crack or flaw on the outside of the curve.

The softest melts shall be selected for rivets, the only requirement as to elastic limit and ultimate strength will be that the ultimate strength shall be at least 60,000 pounds per square inch.

Facilities for testing sample bars shall be furnished by the contractor at a point convenient to the steel works, and the tests shall be made at the expense of the contractor and under the direction of the Engineer. Tests may also be made from time to time on samples cut from finished plates, shapes and bars which shall show results substantially conforming to those shown by the sample tests of the same melts.

All sheared edges or punched holes in steel work shall be subsequently planed or drilled out, so that none of the rough surface is ever left upon the work. Steel for pins shall be sound and entirely free from piping.

Wrought Iron.—The iron used in tension members shall be double refined (high test) iron; muck bars may be used at the center of the pile, but shall not constitute more than one third of the total pile. Small samples having a minimum length of eight inches, shall be furnished by the contractor for testing, as directed by the engineer; these samples shall show an elastic limit of at least 26,000 pounds, and an ultimate strength of at least 50,000 pounds per square inch, shall elongate at least 15 per cent. and show a reduced area of at least 25 per cent. at the point of fracture. The fracture shall be of uniform fibrous character, free from crystalline appearances.

Small samples, having a minimum length of eight inches, shall be furnished by the contractor from the iron used in shapes, plates and other miscellaneous forms as directed by the Engineer; these samples will show an elastic limit of at least 24,000 pounds, and an ultimate strength of at least 47,000 pounds per square inch, shall elongate at least 10 per cent. before breaking, and show a reduction of area of at least 15 per cent. at the point of fracture. In plates more than thirty inches wide an elongation of 8 per cent. and a reduction of 12 per cent. at the point of fracture will be considered satisfactory.

Cast iron shall be of the best quality of tough, grey iron.

RIVETED WORK

All plates, angles and channels shall be carefully straightened before they are laid out; the rivet holes shall be carefully spaced in truly straight lines; the rivet heads shall be of hemispherical pattern and the work shall be finished in a neat and workman-like manner. Surfaces in contact shall be painted before they are put together. The dimensions given for rivets on the plans are the diameters of the rivets before driving.

Power riveters shall be direct acting machines, capable of exerting a yielding pressure and holding on to the rivet when the upsetting is completed.

Steel.—The several parts of each steel member shall be assembled and the holes shall be drilled, the sharp edge of the drilled hole shall be trimmed so as to make a slight fillet under the rivet head, and the pieces shall be riveted together without taking apart. Should the contractors desire, the parts may be punched with holes not exceeding 4 5 the diameter of the finished hole, and this punching shall be so ac-

curate that at least 1/16 of an inch of metal is taken out all around in drilling the hole. All rivets in steel members shall be of steel; the rivet holes shall be of such size that they will fill the hole before driving, and whenever possible the rivets shall be driven by power. All bearing surfaces shall be truly faced. The chord pieces shall be fitted together in the shop in lengths of at least five panels and marked; when so fitted there shall be no perceptible wind in the length laid out. The pin-holes shall be bored truly so as to be at exact distances, parallel with one another, and at right angles to the axis of the member.

Wrought Iron.—All wrought-iron shall be punched accurately with holes 1/16 of an inch larger than the size of the rivet, and when put together a cold rivet shall pass through every hole without reaming. So far as possible all rivets shall be driven by power. The holes for the rivets connecting the floor-beams with the posts and bolsters and the stringers with the floor-beams, and, in general, the holes for all rivets which must be driven after erection, shall be accurately drilled to an iron templet. The holes for the rivets connecting the floor-beams with the posts shall be 1 inch in diameter, and the rivets of corresponding diameter. The pin holes in the vertical posts shall be truly parallel with one another, and at right angles to the axis of the posts. The posts shall be straight and free from wind.

FORGED WORK.

The heads of the steel eye-bars shall be formed by upsetting and forging into shape by such process as may be accepted by the Engineer. No welds will be allowed. After the working is completed, the bars shall be annealed by heating them to a uniform dark red heat throughout their entire length and allowing them to cool slowly. The form of the heads of steel eye-bars may be modified to suit the process in use at the contractor's works, but the form of head adopted must be such as to meet the requirements of the tests of full sized bars.

The heads and the enlarged ends for screws in laterals, suspenders and counters shall be formed by upsetting or by an upsetting and welding process acceptable to the engineer. Welds in the body of the bar will not be allowed.

TESTS OF FULL-SIZED BARS.

Ten full-sized steel eye bars of sections and lengths used in the actual work shall be selected by the inspector for testing, each of these full-sized bars shall be strained till an elongation of 10 per cent. is obtained, and if possible broken; if broken, the fracture shall occur in the body of the bar and shall show a uniform and ductile quality of material.

The contractor will be required to furnish facilities for testing the full sized bars within a reasonable distance of his works. Should the contractor be unable to furnish such facilities, he shall be required to furnish bars at 20 per cent. larger section than those called for, without charge for the increased weight.

The full-sized bars shall be selected from time to time as the work proceeds, the last bar not to be selected till all the eye bars are manufactured. The tests shall be made from time to time as the bars are selected. When three bars have been tested, the bars manufactured up to the time of the selection of these three test bars shall be accepted or rejected as the results of such tests, and the same shall be done again when three more bars are tested. In the tests, the failure of one bar to develop a stretch of 10 per cent. before breaking, shall be sufficient reason for rejecting the whole lot, but a failure to break in the body of the bar shall not be a sufficient ground for condemnation if it does not occur in more than one third of the bars tested. Should the contractor on the first attempt fail to make bars coming up to the required specifications, the engineer may order bars of 20 per cent. larger section than the plans called for, to be furnished by the contractor without charge for the increased weight.

MACHINE WORK.

The bearing surfaces in the top chord shall be truly faced. The ends of the stringers and of the floor-beams shall be squared in a rotary facer. All surfaces so designated on the plans shall be planed.

All pins shall be accurately turned to a gauge, and shall be of full size throughout; pin holes shall be bored to fit the pins with a play not exceeding 1-50 of an inch. These clauses apply to all lateral connections as well as those of the main trusses. Pins shall be supplied with pilot nuts for use during erection, four for each size of pin.

All screws shall have a truncated V thread, United States standard sizes.

MISCELLANEOUS.

All workmanship and material, whether particularly specified or not, must be of the best kind now in use in first class bridge work. Flaws, ragged edges, surface imperfections, or irregular shapes, will be sufficient ground for rejection, rough and irregularly finished work will not be accepted.

Machine-finished surfaces shall be coated with white lead and tallow before shipment; all other parts shall be given a coat of hot boiled linseed oil.

TERMS.

Monthly estimates will be made at the end of each month for the work done during that month. In these monthly estimates, the material delivered at the contractor's shop, but not manufactured, shall be estimated at 50 per cent. of the contract price for finished material in Chicago, and manufactured material at 75 per cent. of the contract price for finished material in Chicago. Payments will be made on or about the 15th day of the following month, according to these estimates, deducting from the amount of the same ten per cent. as security, to be held until the completion of the entire contract.

No material will be paid for which does not form a part of the permanent structure.

All expense of testing shall be borne by the contractor.

TIME.

The deck spans and towers shall be completed and shipped not later than January 1st, 1887. The three through spans shall be completed and shipped in February, March and June, 1887, respectively.

The railroad company may exact a penalty not exceeding $150 per day for failure to complete the work within these specified times.

PROPOSALS.

Separate proposals should be made for the deck spans (including towers) and the through spans.

The prices should be by the pound at separate rates for steel, wrought iron and cast iron. The prices shall include material, and all patterns and other work of every description, and are to be on the basis of finished material delivered on cars at Chicago. Separate proposals shall also be made for erection on the basis of a single gross sum for the erection of the six deck spans (including towers), and a single gross sum for the erection of the three through spans. Erection will include setting wall plates and drilling the necessary holes for anchor bolts. The contractors will be required to furnish all false work and tools of every description, and the plans of such false work shall be subject to the approval of the engineer.

The right is reserved to accept separate proposals for the deck spans and the through spans, to accept proposals for material without erection and to award the contract to other than the lowest bidder.

GEO. S. MORISON,
Chief Engineer Rulo Bridge.

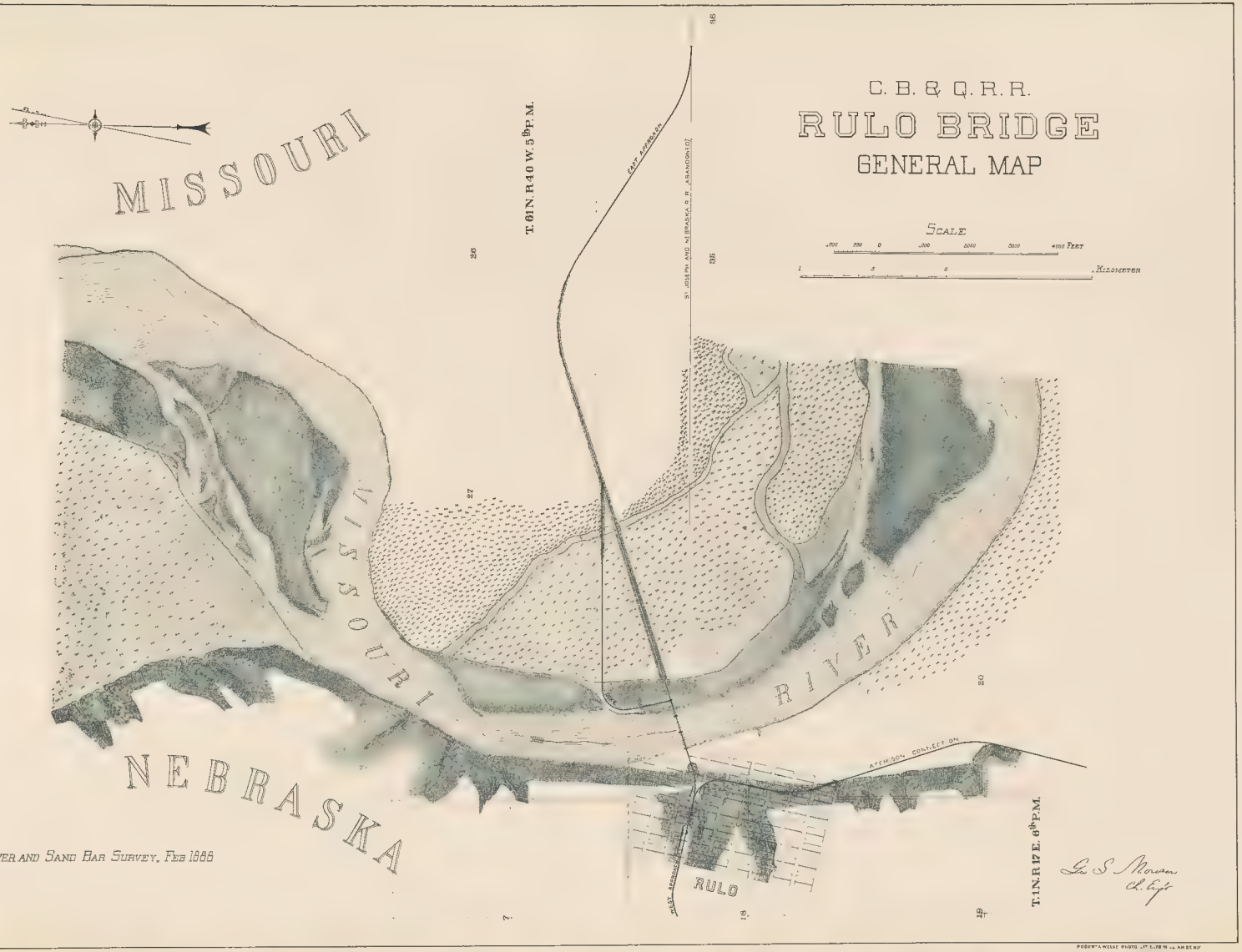
NEW YORK, JULY 20, 1886.

APPENDIX G.

TESTS OF STEEL EYE BARS

TESTS ON FULL-SIZED EYE-BARS

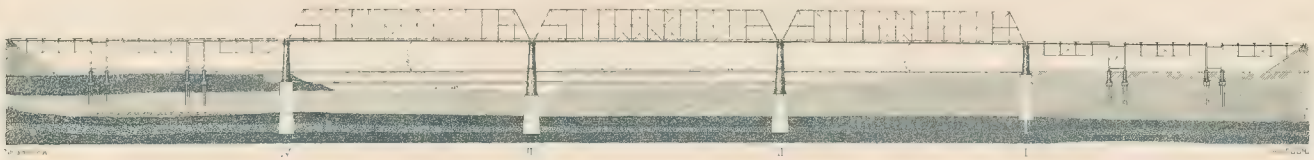
Dimensions,—Inches					Results of Mechanical Tests													
Original					After Testing		Reduction of Area Per Cent.	Extension		Elastic Limit Lbs. per sq. in.	Maximum Load Lbs. per sq. in.	Place of Fracture	Tests on Sample Bars from same Melts.						
Nominal.		Actual.						Gauge Length 8 Inches	Per Cent.				Diameters		Reduction Per Cent.	Extension in 8 Inches Per Cent.	Elastic Limit Lbs. per sq. in.	Maximum Load Lbs. per sq. in.	Per cent. of Phosphorus	Mesh Number.
Width.	Thickness.	Length Centers.	Width.	Thickness.	Width.	Thickness.							Original.	After Testing.						
7	⅞	300.03	6.97	0.76			—	264	—	34270	60450	Head	.739	.545	45.6	22.80	47790	74840	.090	8485
7	1	300.03	6 97	1.01	5.51	0.74	42.08	264	13.77	35350	67220	Body	.750	.535	49.1	25.30	44140	73330	.090	8847
7	1⅛	300.03	6.97	1.52	5.37	0 87	53 90	264	14.75	31570	63262		.750	.530	50.1	26.75	47980	75140	.051	8415
7	1¼	300.03	6.97	1.76		—		264		30925	60020	Head	.743	.475	59.1	26.30	45210	71040	.086	8345
7	1	300.03	6.97	1 01	5.46	0.64	50.36	264	13.67	35350	67800	Body	.750	.535	49.1	25.30	44140	73330	090	8847
7	1⅛	300.03	6.97	1.50	6.60	1.39	12.25	264	9.01	35120	67110	"	734	.510	52 4	24 70	47570	74610	.068	8352
7	1⅜	424 10	6 98	1.62	6 73	0 98	54.67	396	12 11	36070	67100	"	740	.545	45 8	23.00	46040	75340	.076	8339
7	1⅜	424.10	7.00	1.61	5.57	1.22	39.70	396	11.43	33120	63340	"	741	.486	57.0	24.60	45460	74210	.075	8330
7	1⅝	424.09	6.98	1.26	5.85	1 02	33 15	396	11 24	32930	61210	"	.745	.550	46.1	22.00	45170	75800	.048	8419
5	¾	422.97	5.01	0.76	4.00	0.54	43.27	396	8 65	38340	61340	"	.748	.510	53.5	24.37	46240	76690	.062	8367
5	¾	422.72	5 00	0.77	3.70	0.48	53.87	396	9.78	42365	69325	"	.746	.510	53.3	24.80	44330	71380	.076	8223
7	1¾	300.03	7.00	1 75	5.20	1.23	47.62	264	13.37	33300	63270	"	.758	.560	45 4	24.10	45200	72680	-	9303
7	⅞	299.61	6.97	.78	5.41	0.53	47.51	264	13.32	30140	67530	"	.755	.535	49.8	23.30	46680	74370	.086	9046


C. B. & Q. R. R.
RULO BRIDGE
GENERAL MAP
SCALE
1 Kilometer
MISSOURI
NEBRASKA
MISSOURI RIVER
T. 6 N. R 40 W. 5th P. M.
T. 1 N. R 12 E. 6th P. M.
ST. JOSEPH AND NEBRASKA R. R. (ABANDONED)
EAST APPROACH
ATCHISON CONNECTION
RULO
River and Sand Bar Survey, Feb 1888
Geo. S. Morison
Ch. Engr.

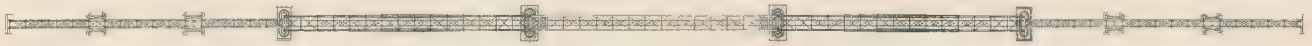
C. B. & Q. R. R.

RULO BRIDGE

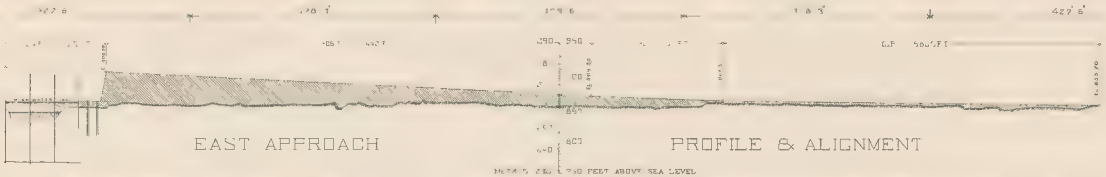
GENERAL ELEVATION, PLAN, PROFILE & ALIGNMENT



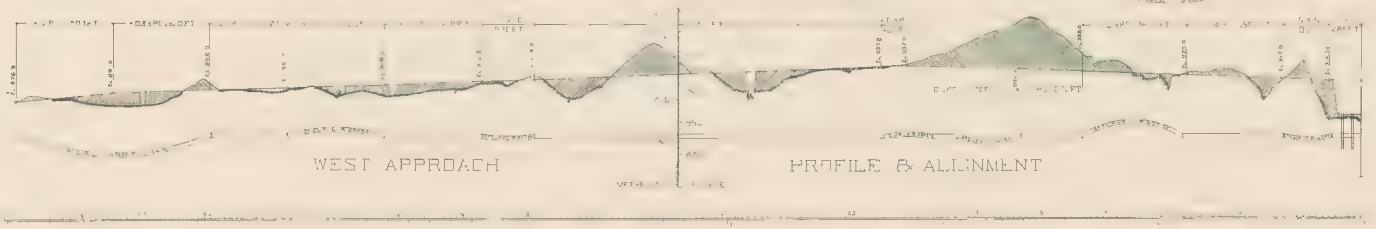
ELEVATION



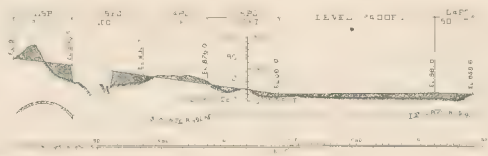
PLAN



EAST APPROACH PROFILE & ALIGNMENT



WEST APPROACH PROFILE & ALIGNMENT

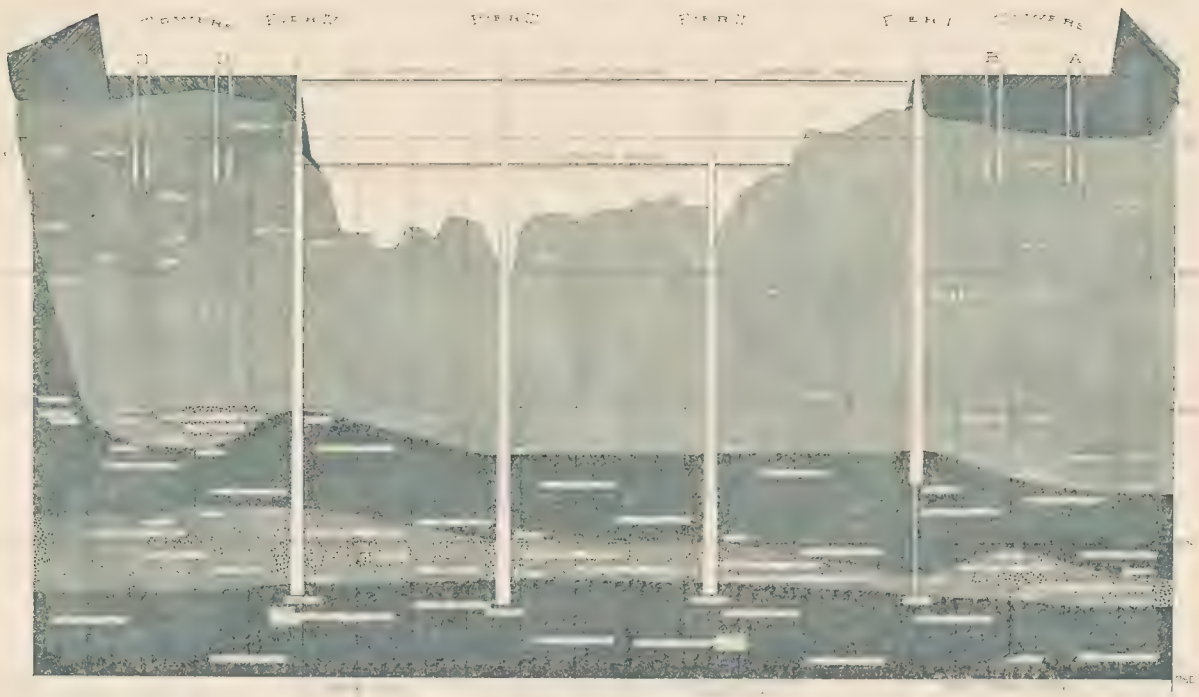


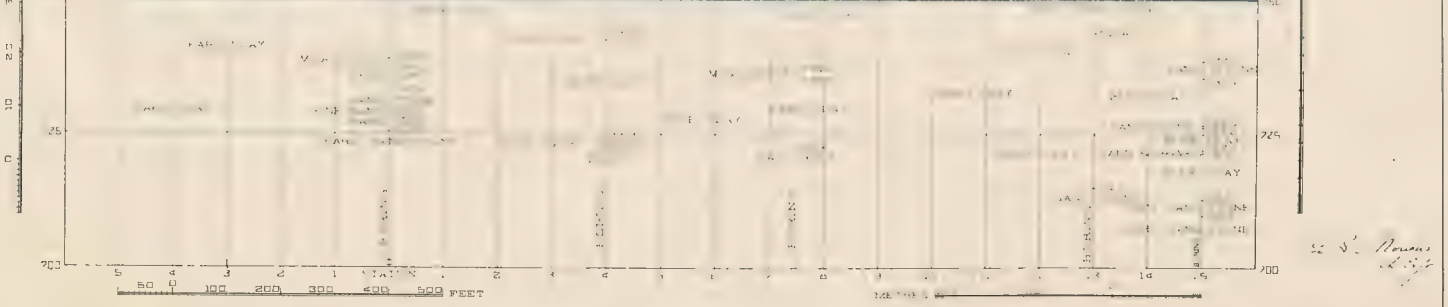
ALTERN CONNECTION PROFILE & ALIGNMENT

C. E. S. Mouse
Chief

C B. & Q. R. R.

RULO BRIDGE

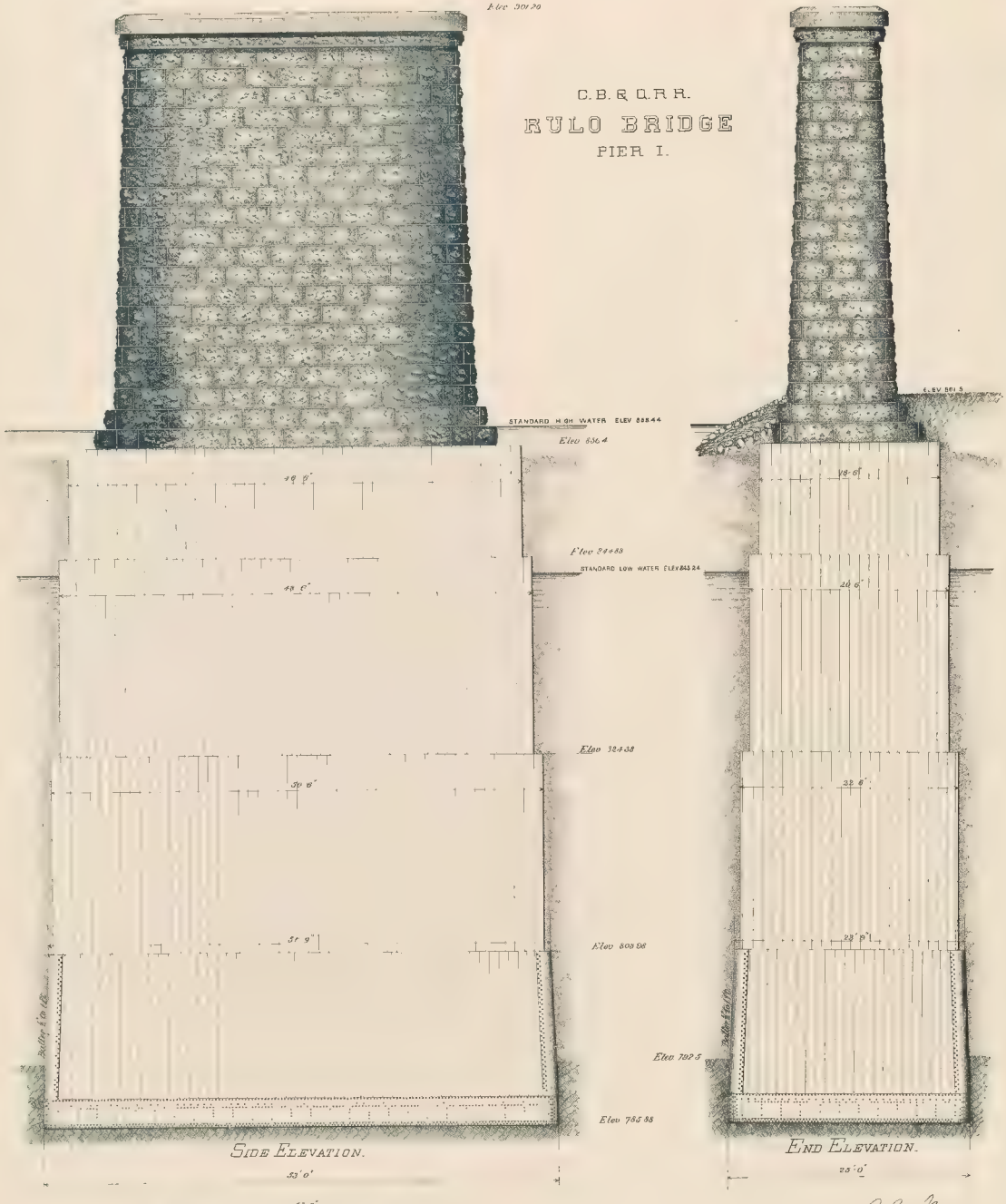




C. B. & Q. R. R.

RULO BRIDGE

PIER I.



SIDE ELEVATION.

END ELEVATION.

PLAN

L. S. Marsh
A. C. E.

Scale

Feet

Meters

Scale of Plan

Feet

Meters

Plate 4

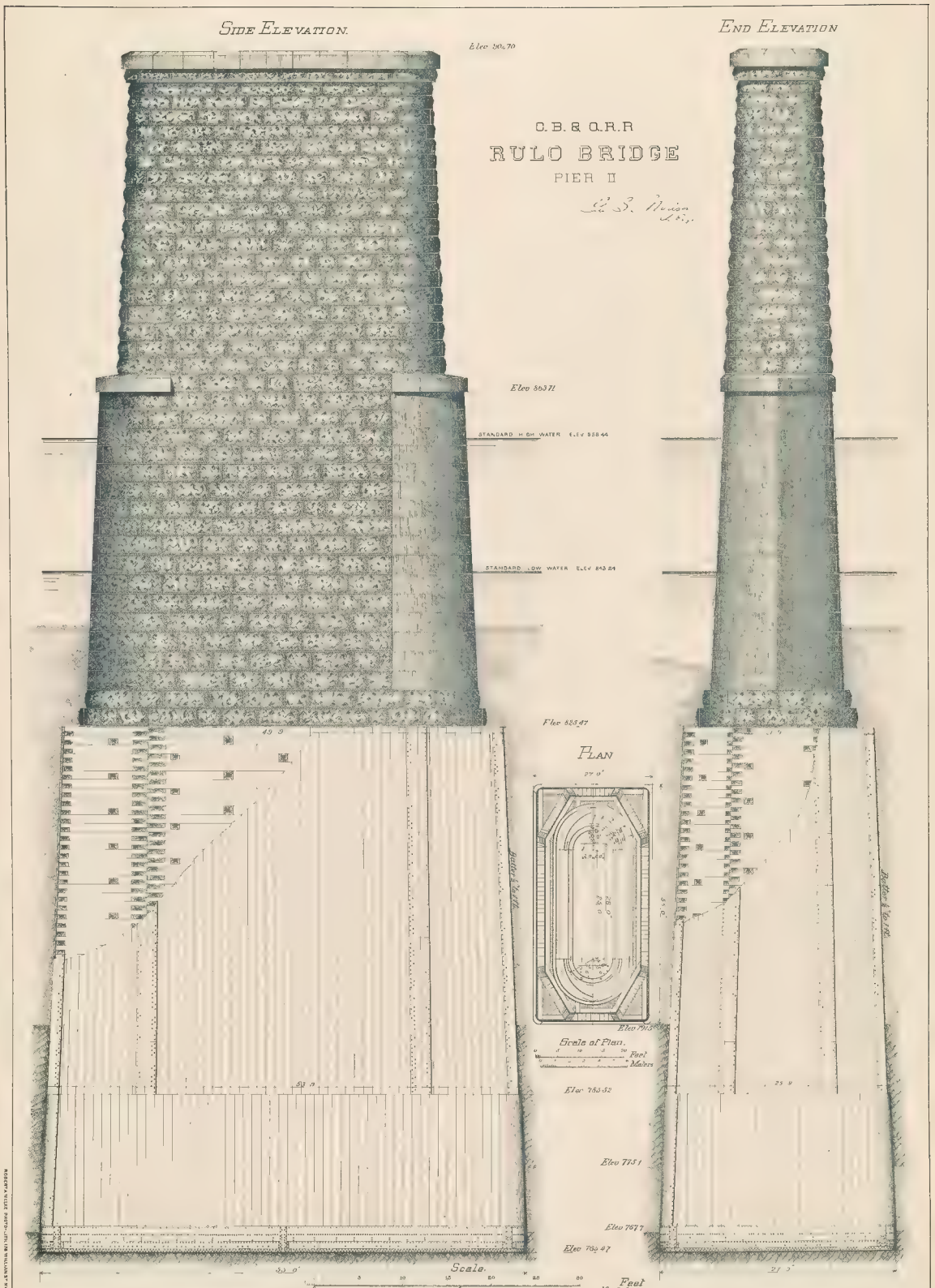

Side Elevation.
End Elevation
Elev 880.70
C.B. & Q.R.R
RULO BRIDGE
PIER II
Elev 863.71
STANDARD HIGH WATER ELEV 858.44
STANDARD LOW WATER ELEV 843.84
Elev 825.47
Plan
Elev 791.3
Scale of Plan.
Feet
Meters
Elev 765.32
Elev 713.1
Elev 767.7
Elev 750.97
Scale.
Feet
Metres

Plate 5

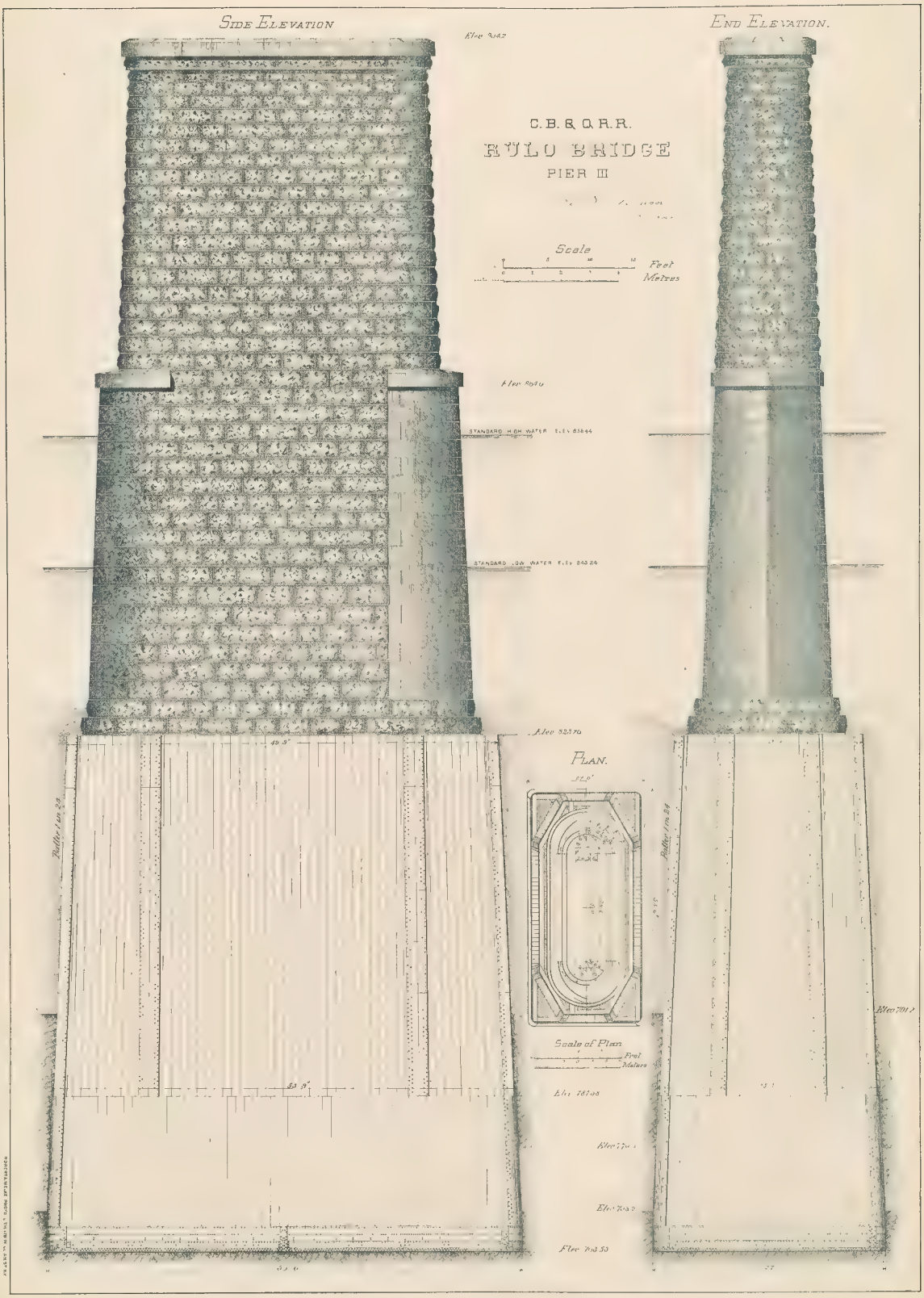

SIDE ELEVATION
END ELEVATION.
C.B.&Q.R.R.
RÜLO BRIDGE
PIER III
Scale
Feet
Metres
STANDARD HIGH WATER
STANDARD LOW WATER
PLAN.
Scale of Plan
Feet
Metres

Plate G

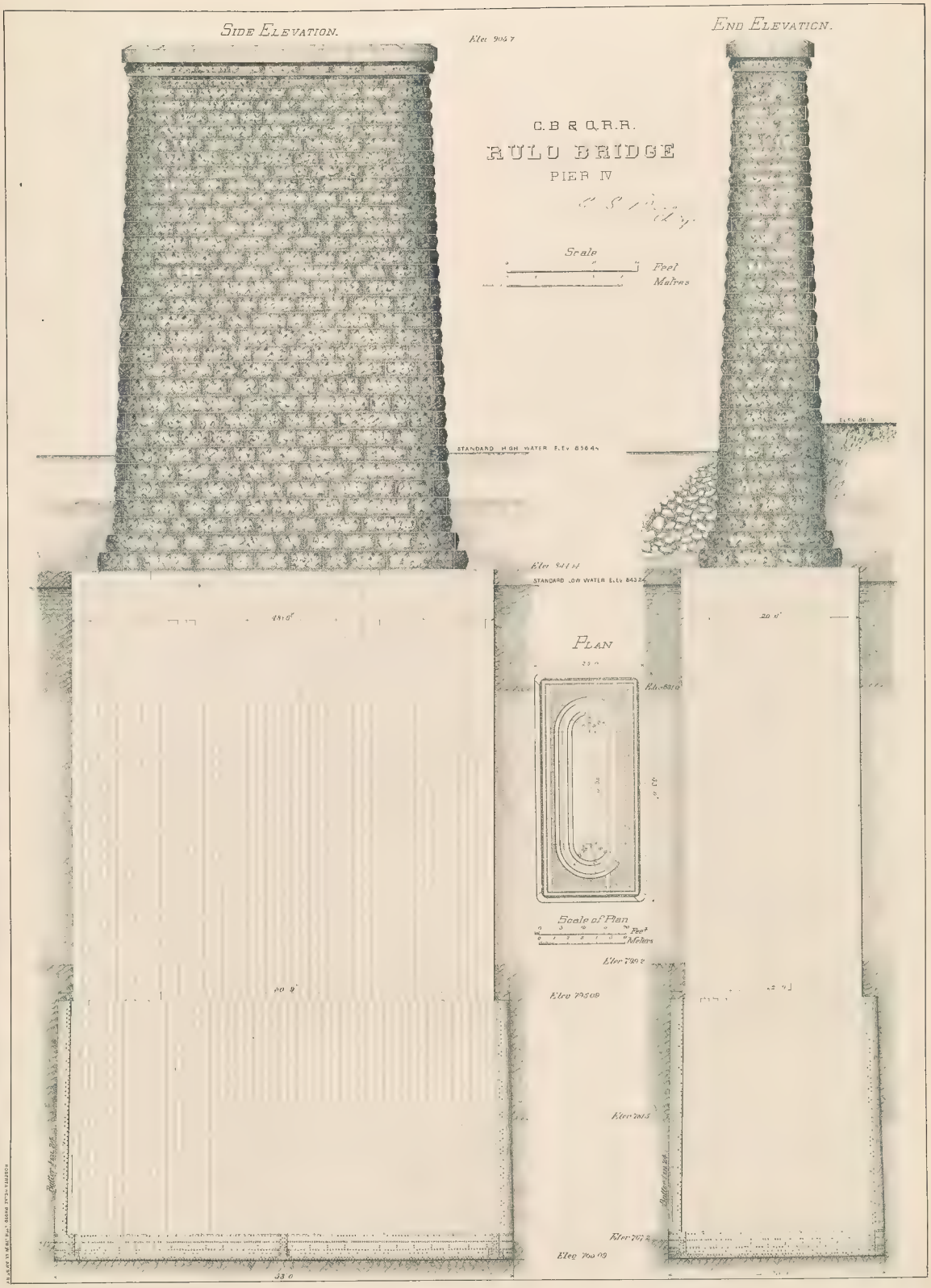
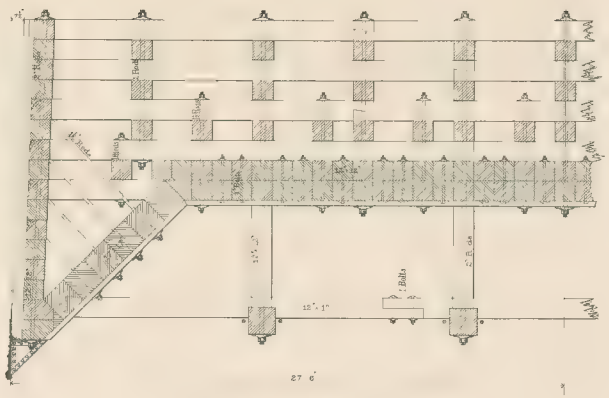

Side Elevation.
End Elevation.
C.B & Q.R.R.
RULU BRIDGE
PIER IV
Scale
Feet
Metres
STANDARD HIGH WATER E.Lev 856.4
STANDARD LOW WATER E.Lev 843.2
Plan
Scale of Plan
Feet
Metres
Elev 907.7
Elev 841.14
Elev 831.0
Elev 790.2
Elev 795.08
Elev 701.3
Elev 767.4
Elev 760.09
49.6'
20.0'
40.9'
33.0

Plate 7.

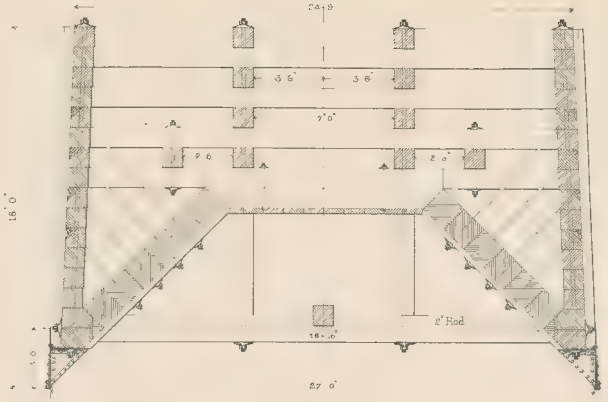
C. B. & Q. R. R.

RULO BRIDGE

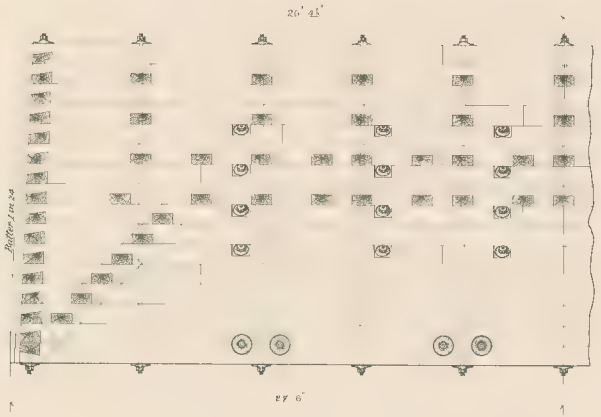
CAISSONS II & III



HALF LONGITUDINAL SECTION.



CROSS SECTION.



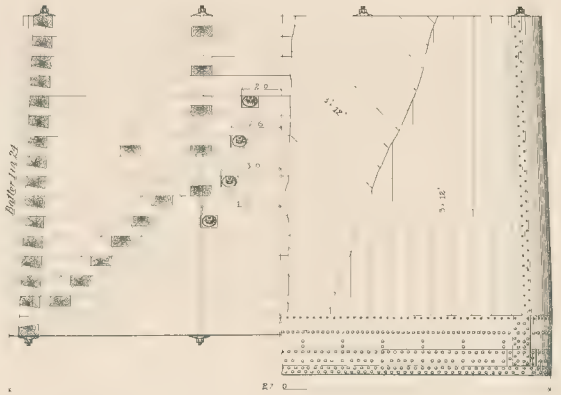
Cutting edge and planking removed.

HALF SIDE ELEVATION.

Scale

Feet

Metres



END ELEVATION.

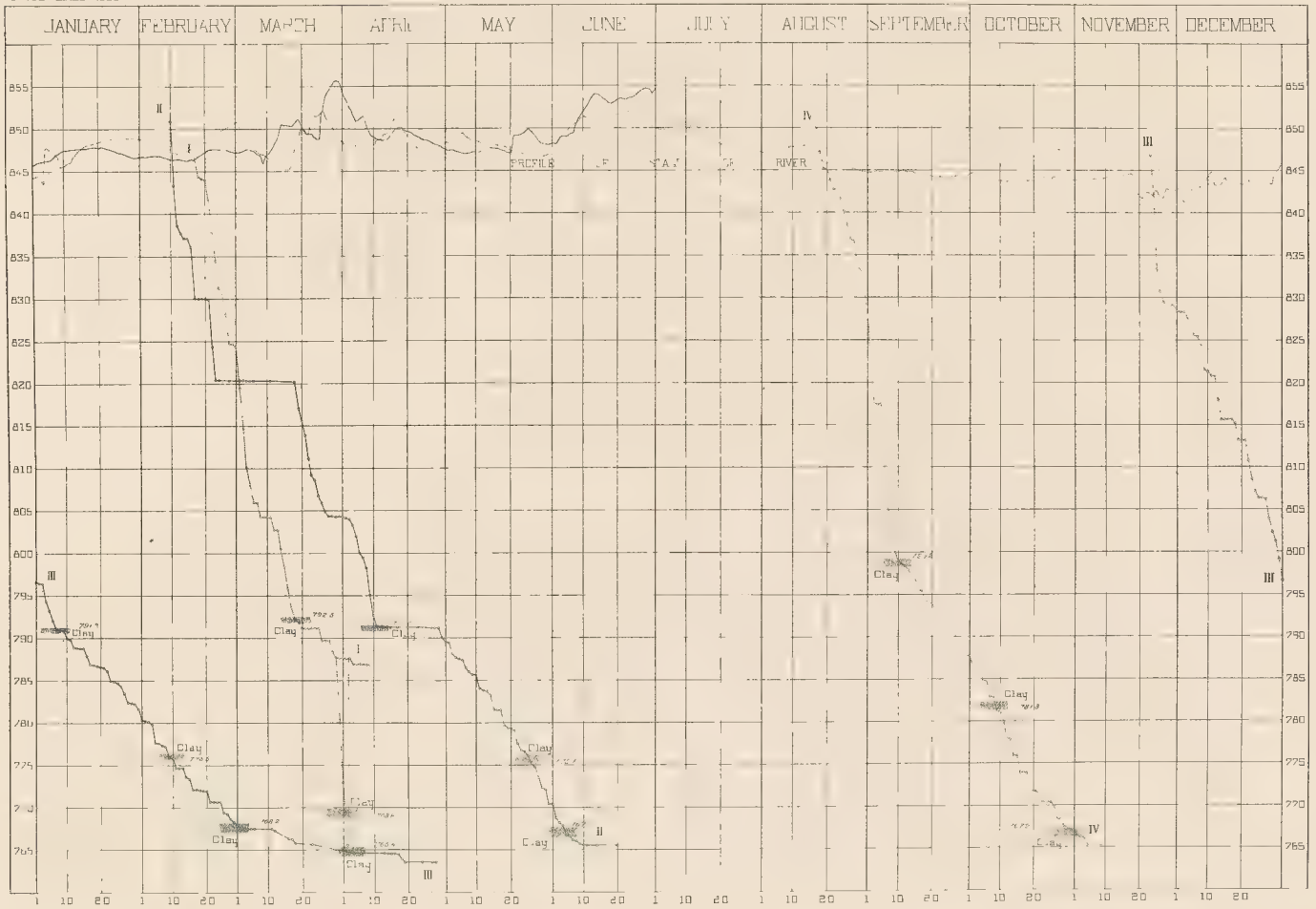
E. S. Nouse
Chief

C. B. & Q. R. R.

RULO BRIDGE

DIAGRAM SHOWING RATE OF PROGRESS IN SINKING CAISSONS

DOTTED LINES 1886 — FULL LINES 1887



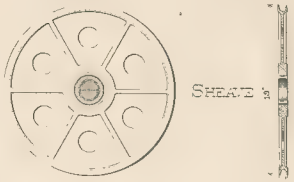
ROBERTA WELCH PHOTO-LITH. NEW YORK

C.B.&Q.R.R.

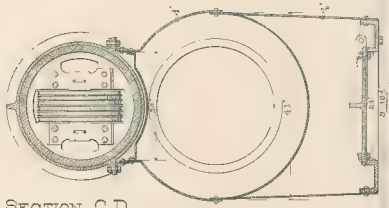
RULO BRIDGE

CLAY HOIST.

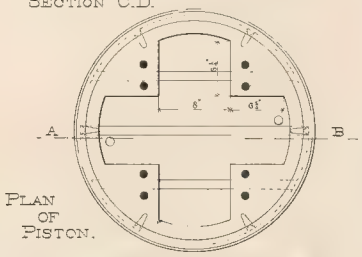
BEARINGS FOR BOTTOM SHEAVE.



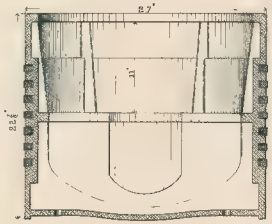
SHEAVE



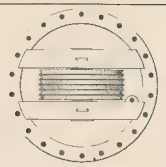
SECTION C.D.



PLAN OF PISTON.

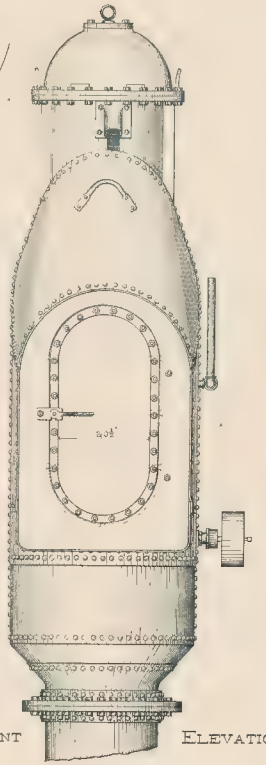


SECTION OF PISTON.

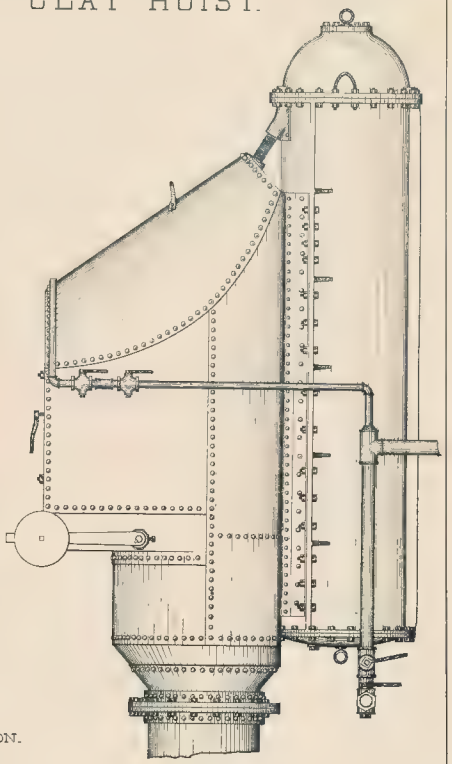


BEARINGS FOR TOP SHEAVE

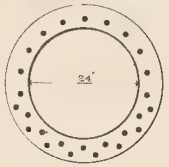
SECTION THROUGH CENTRE.

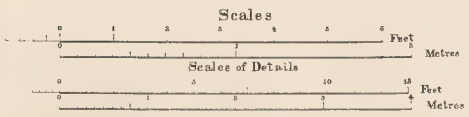


FRONT ELEVATION.



SIDE ELEVATION.





CAST IRON
WROUGHT IRON
BRASS

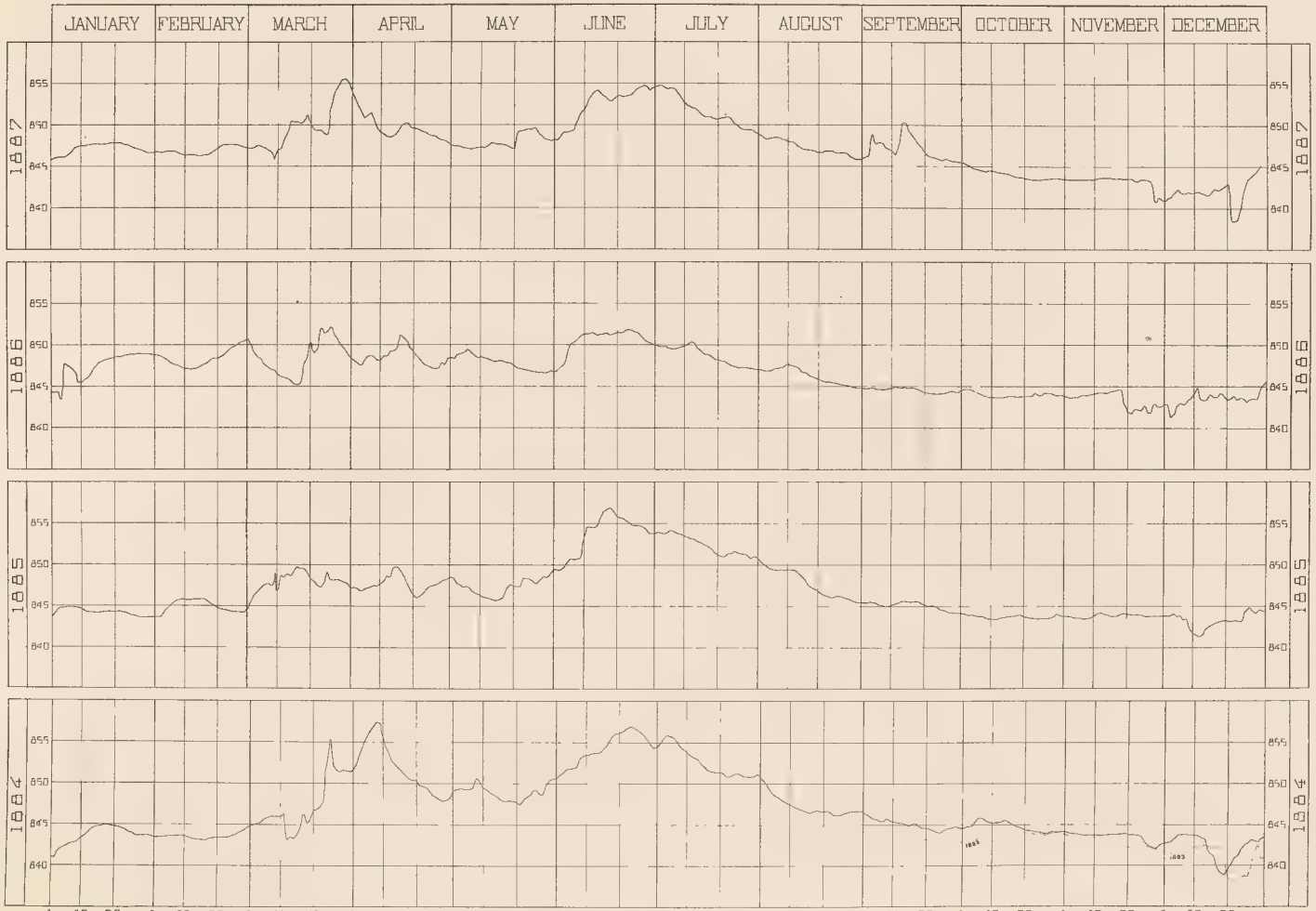
Geo. S. Morison
Ch. Engr.

C.B. & Q.R.R.

RULO BRIDGE

RECORD OF WATER STAGE OF THE MISSOURI RIVER AT RULO NEBRASKA.

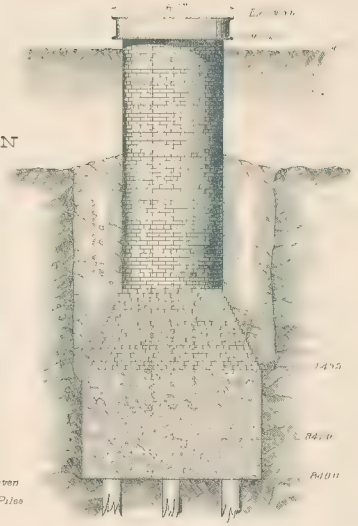
E. S. Nevins
C. E.



C. B. & Q. R. R.

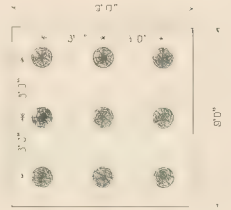
RULO BRIDGE

APPROACH PIERS

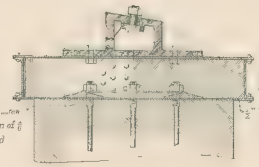


ELEVATION

Excavated to 845 and piles driven
Then excavated to 840 and Piles cut off at 842
Piles driven generally to 810



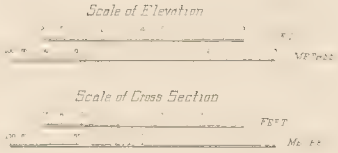
PLAN OF PILING



After getting a fair bearing on ... screwing continued till elongation of ... (2000 lbs per sq in.) was obtained

Filled with Concrete when in place, before top plate was put on

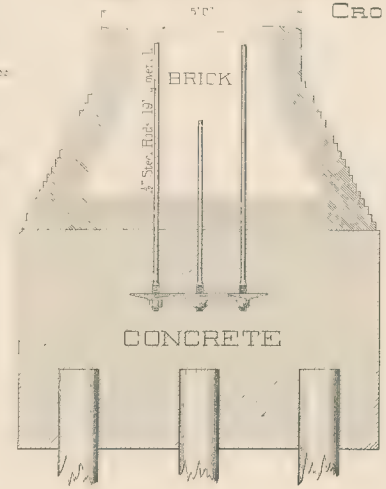
½" Plate 6'0" diam



Scale of Elevation

Scale of Cross Section

FEET

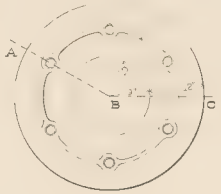


CROSS SECTION

BRICK

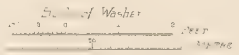
CONCRETE

ANNULAR CAST WASHER

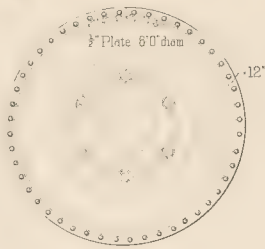


PLAN

SECTION ABC.



FEET



½" Plate 6'0" diam

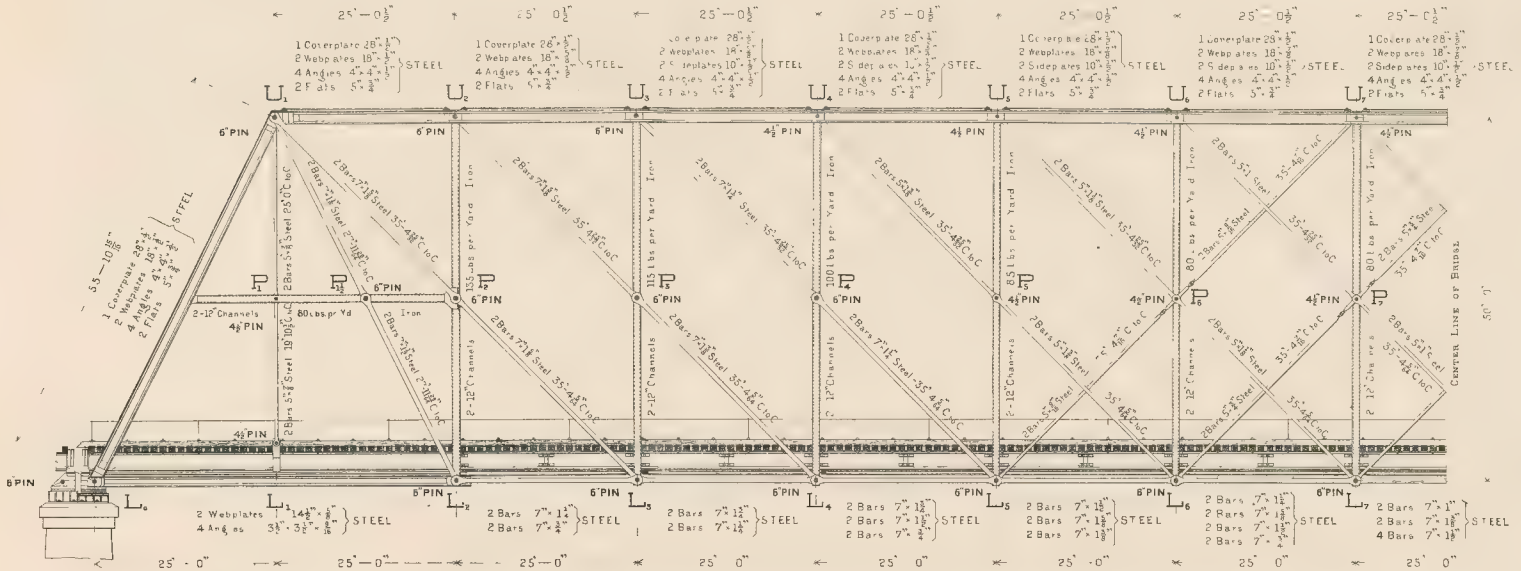
12" Channel - 60 lbs pr yd

TOP VIEW

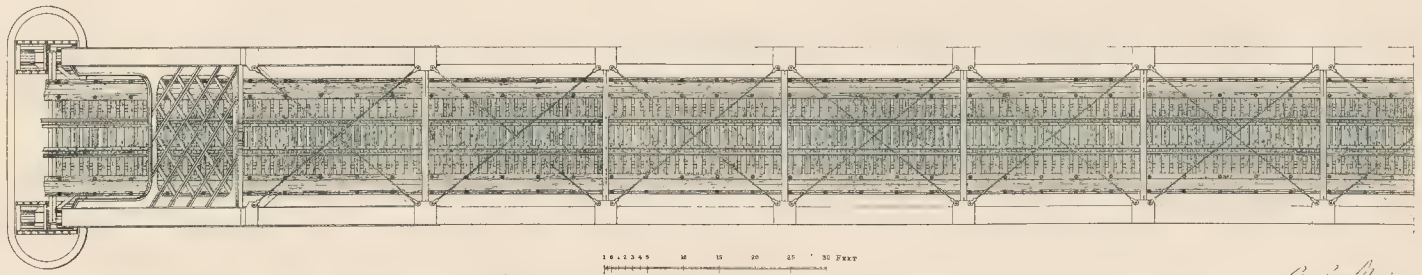
G. S. Morison
C.E.

C. B. & Q. R. R. RULO BRIDGE THROUGH SPAN

General Elevation of 375'-0" Span



General Plan of 375'-0" Span



Scales: 16 Feet

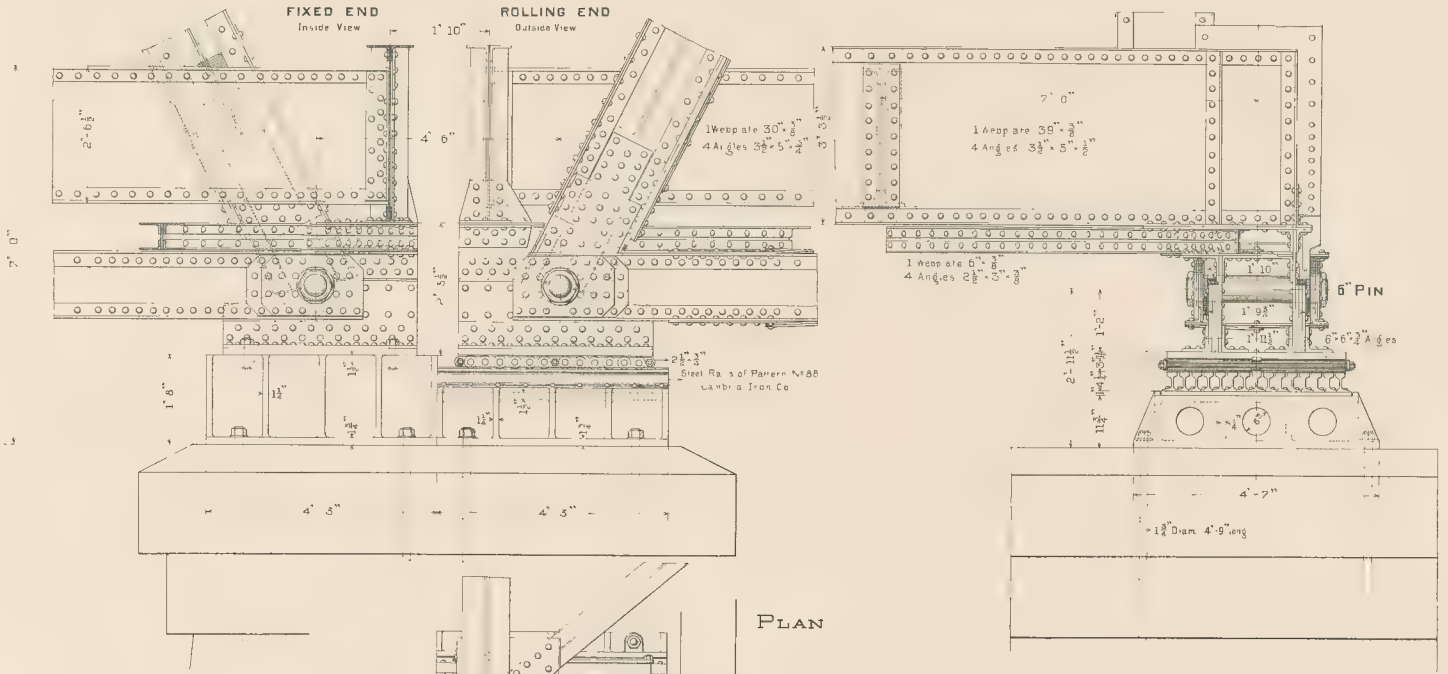
5 Meters

Geo. S. Morison
Ch. Engr.

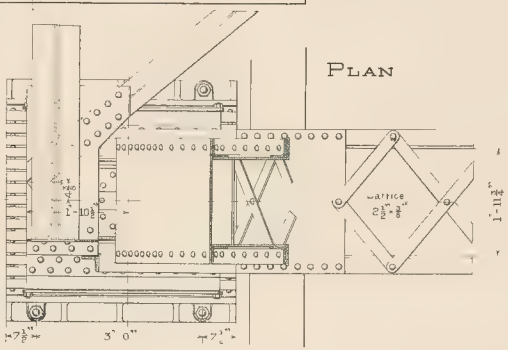
C. B. & Q. R. R. RULO BRIDGE THROUGH SPAN

Details of 375'-0" Span

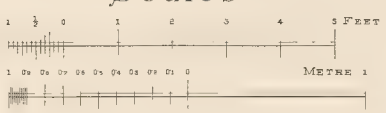
Side Elevation — Panel Point Lo — End Elevation



Plan



Scales:

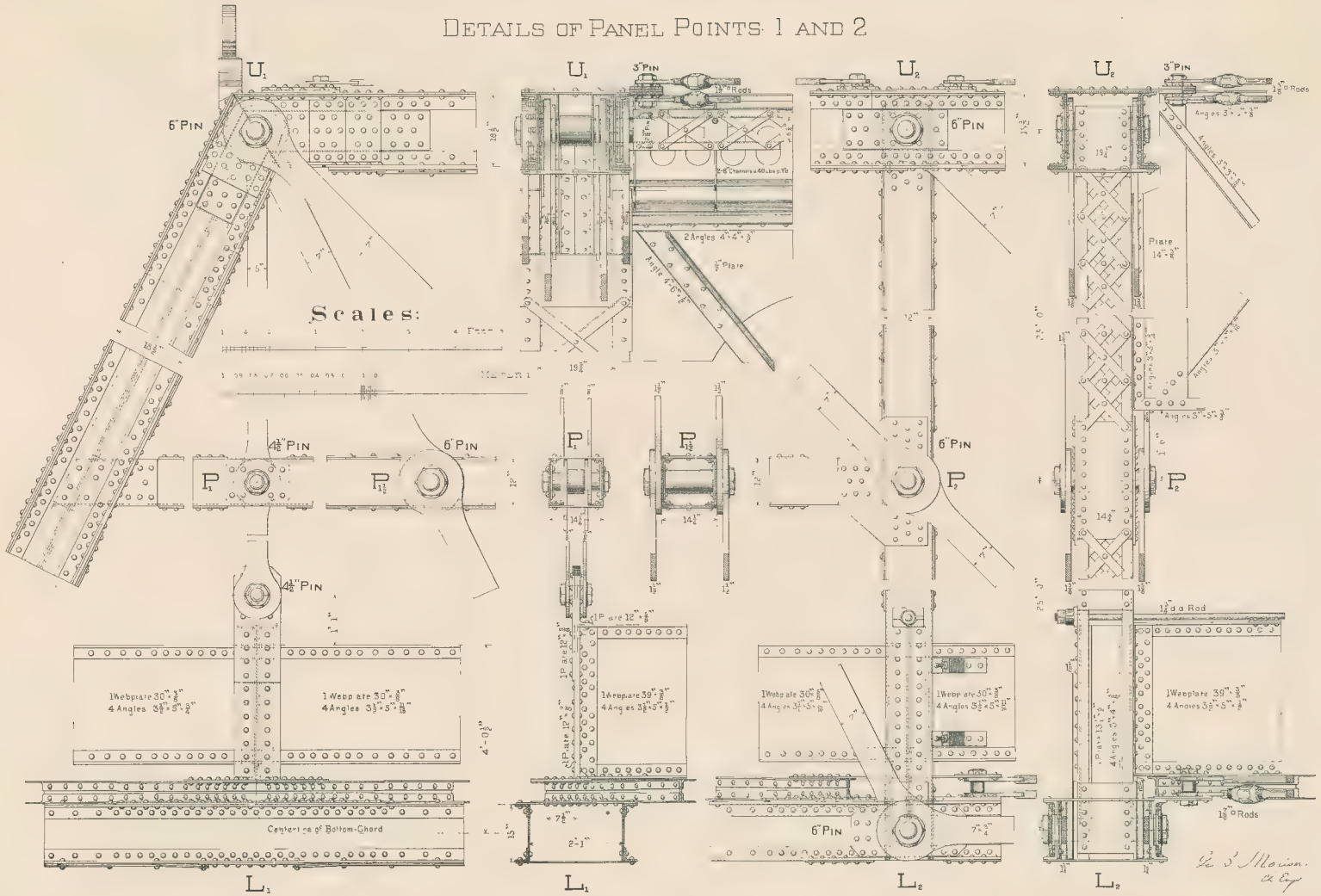


L. S. Rowan
C.E. Engr

ROBERTA MILKE PHOTO LITH 78 WILLIAM ST N.Y.

C. B. & Q. R. R. RULO BRIDGE THROUGH SPAN

Details of Panel Points 1 and 2

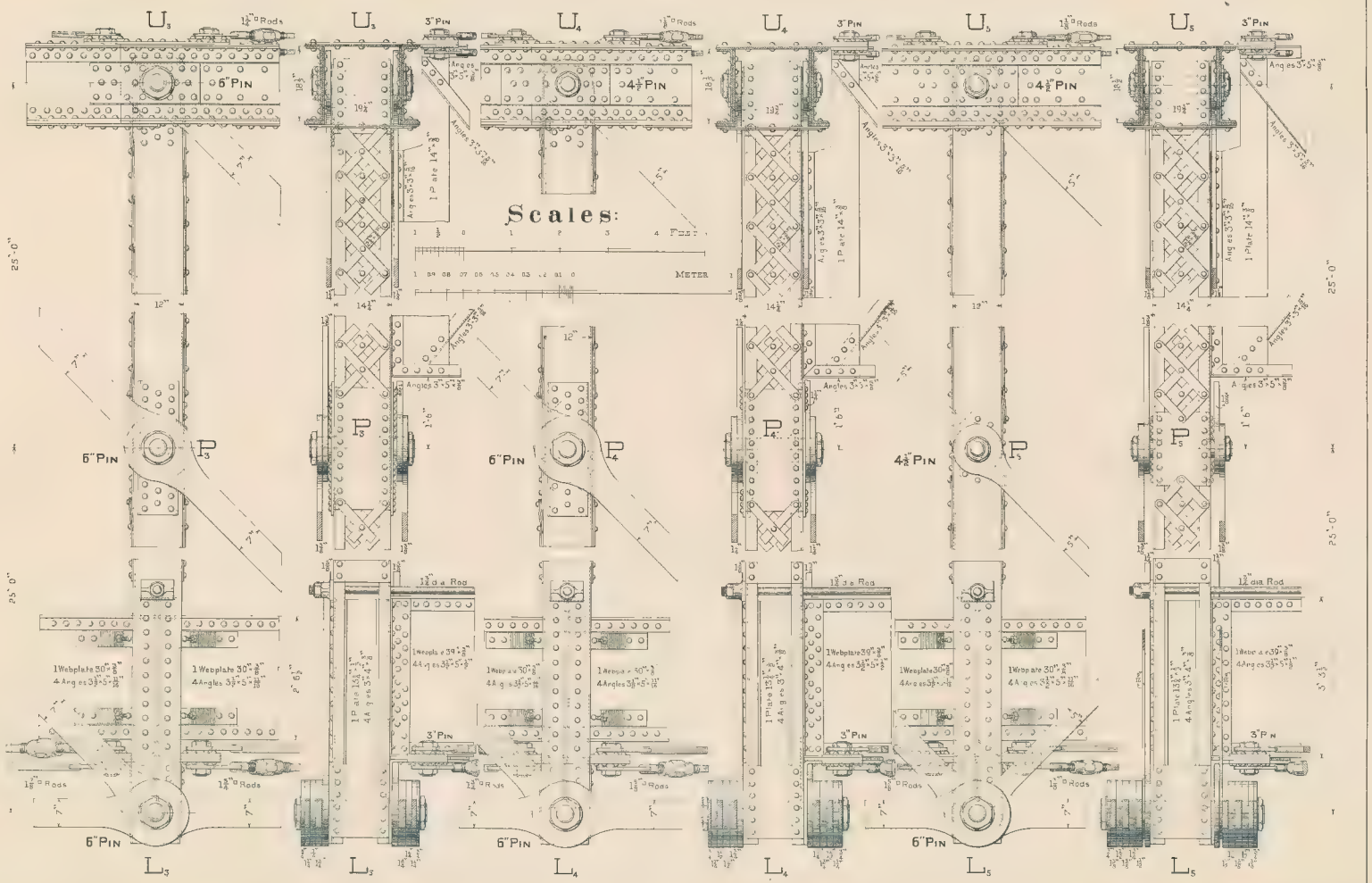


Geo. S. Morison, C.E.

ROBERTS & WELLS PHOTO-LITH. 78 W. LAKE ST. CHICAGO

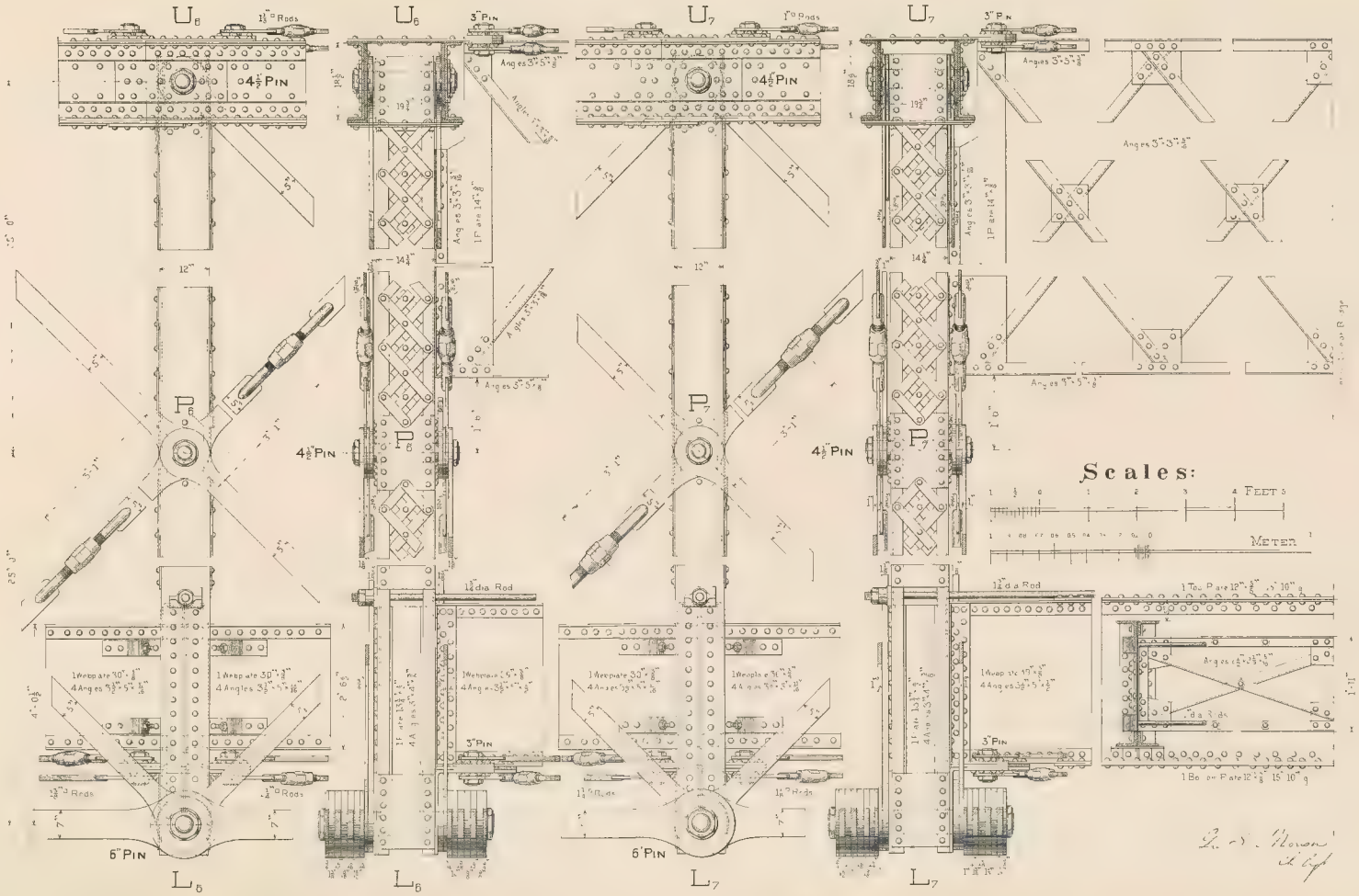
C. B. & Q. R. R. RULO BRIDGE THROUGH SPAN

Details of Panel Points 3, 4 and 5.



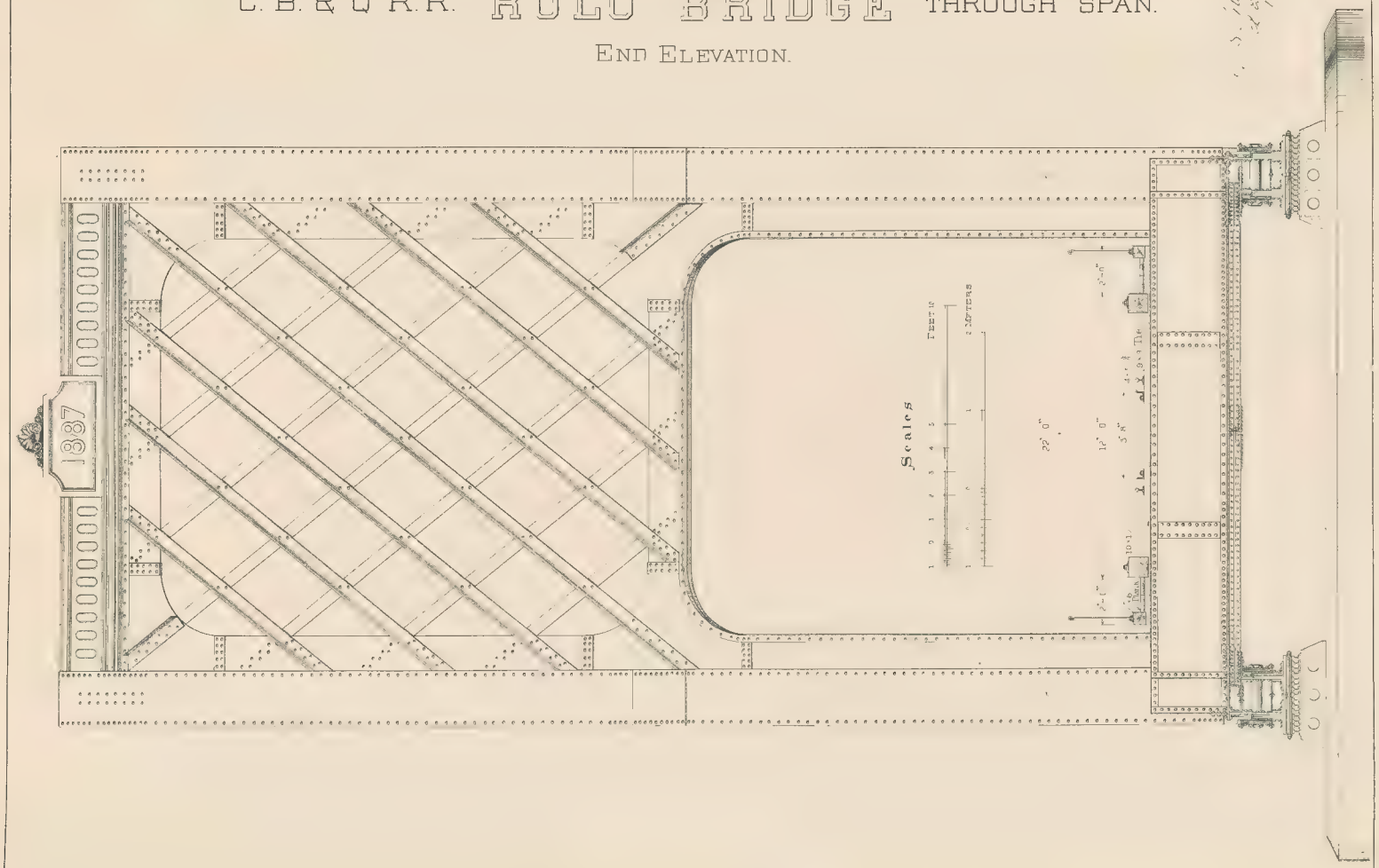
C. B. & Q. R. R. RULO BRIDGE THROUGH SPAN

Details of Panel Points 6 and 7



C. B. & Q R.R. RULO BRIDGE THROUGH SPAN.

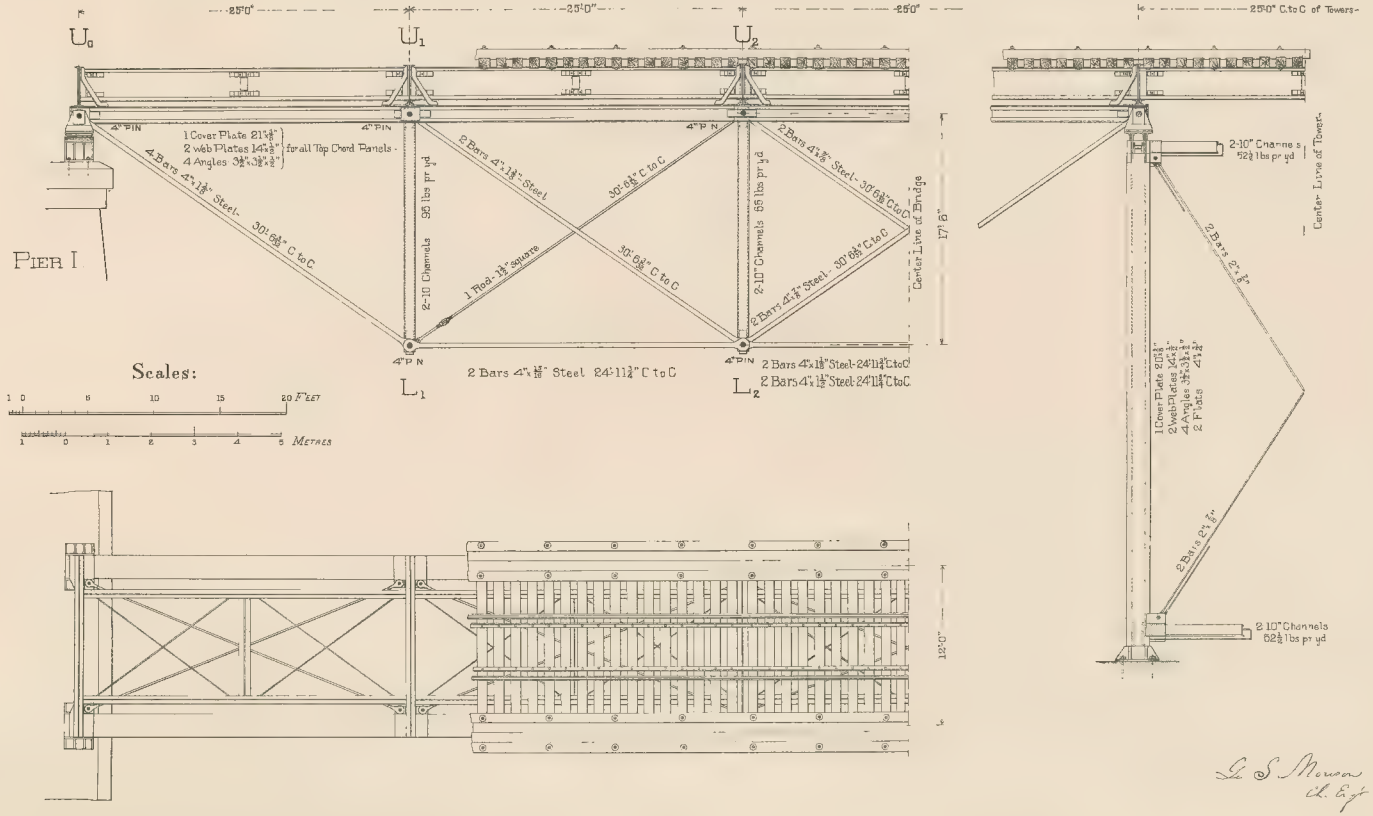
End Elevation.



ROBERTA WEBB PHOTO LITH. 76 W. LEAVITT ST. N.Y.

C. B. & Q. R. R. RULO BRIDGE 125 FT DECK SPAN

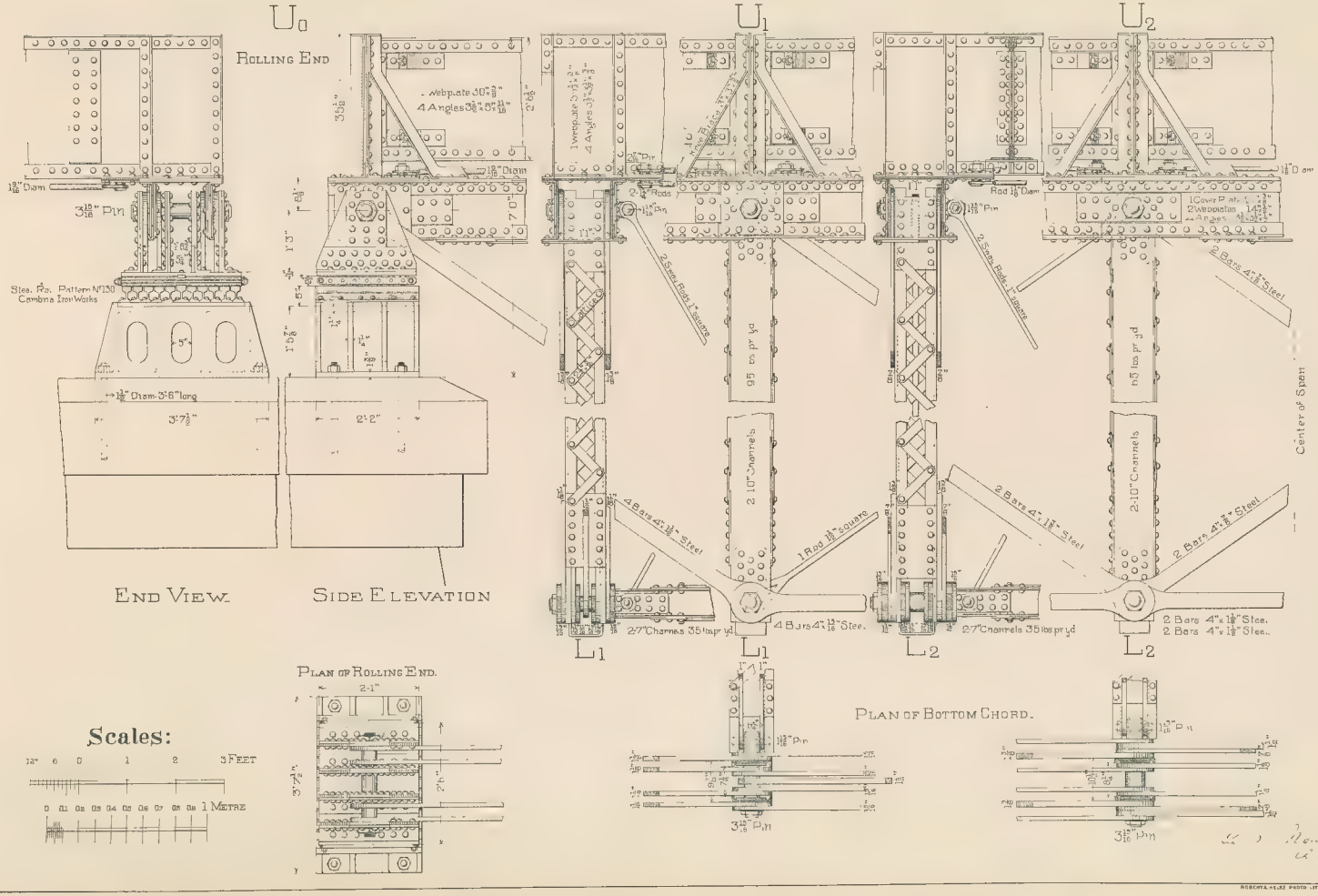
General Elevation and Plan



L. S. Morse
C. E.

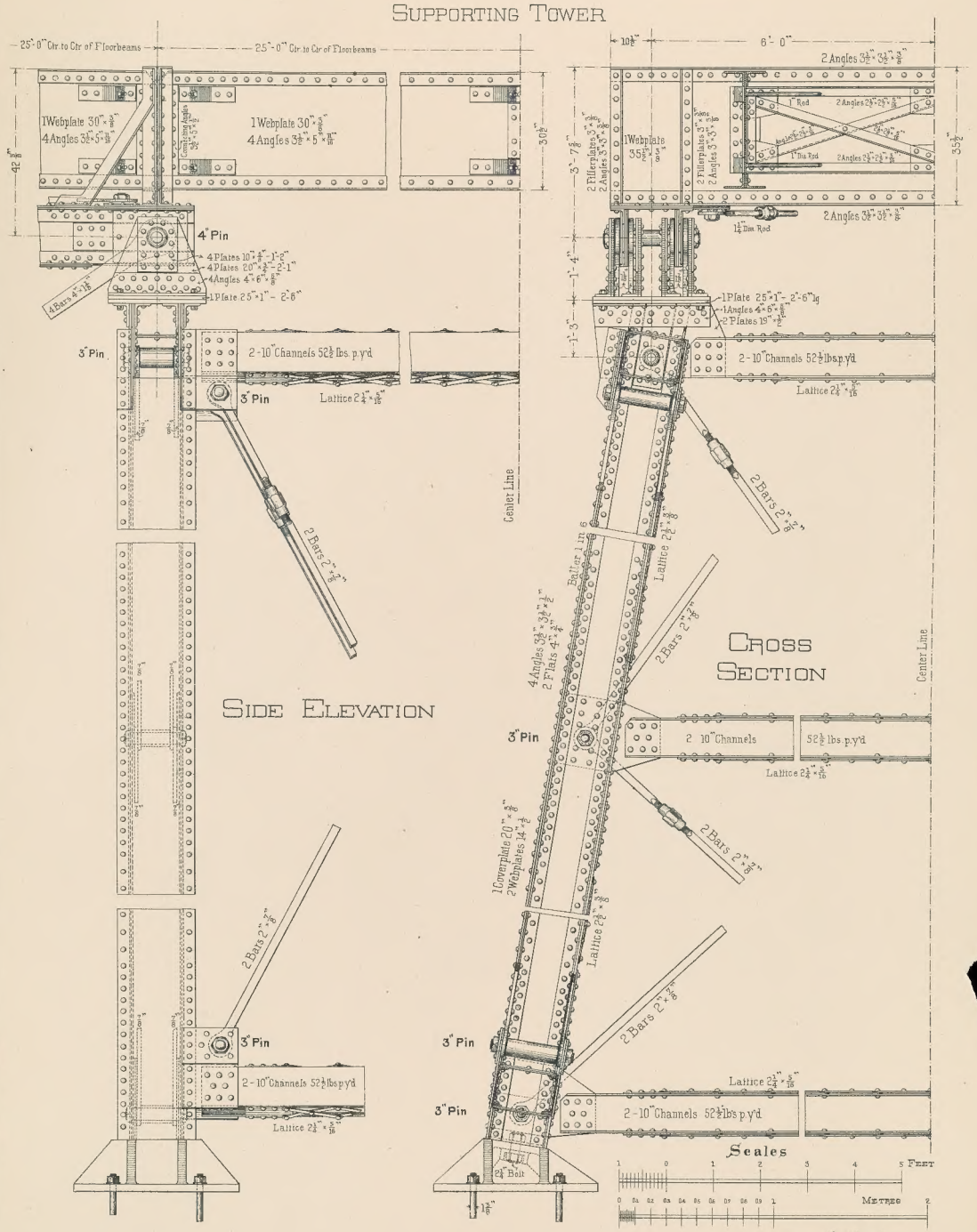
C. B. & Q. R. R. RULO BRIDGE 125 FT DECK SPAN

Details of Panel Points 0, 1 and 2



C.B.&Q.R.R. RULO BRIDGE 125FT DECK SPAN

SUPPORTING TOWER



G. S. Morison
Ch. Engr.

ROBERT A. WELLE PHOTO-LITH 178 WILLIAM ST. N.Y.

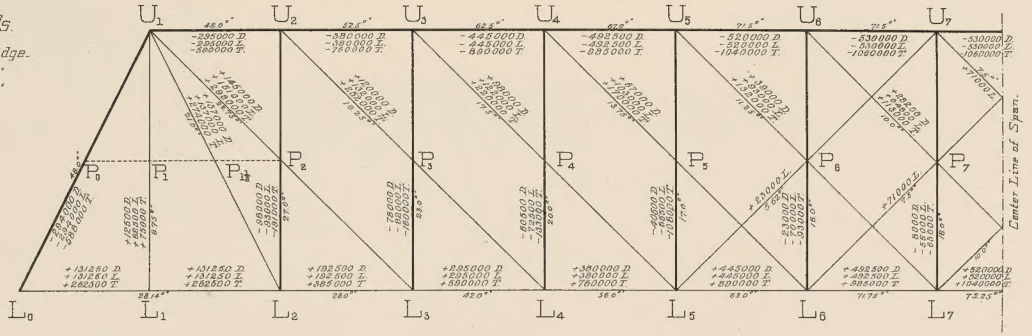
Plate 21

C. B. & Q. R. R. RULO BRIDGE STRAIN SHEET

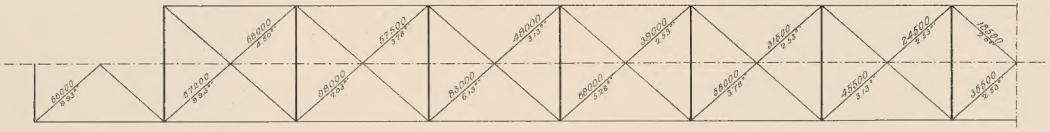
375 FT. THROUGH SPAN

Assumed Loads.

D L 3000 lbs pr ft of Bridge.
L L 3000 " " "
E L 5000 " " "

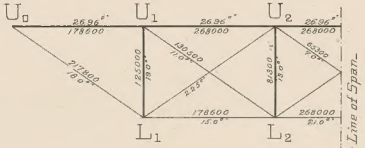


Top Lateral System.

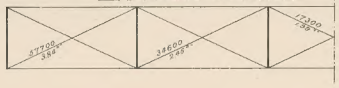


Bottom Lateral System.

125 FT. DECK SPAN



Lateral System.



5000 lbs pr ft. all moving load.

500 lbs pr ft wind pressure.

G. S. Morison
Ch. Eng.

ROBERT A WELCHE PHOTO-LITH. 173 WILLIAM ST. N.Y.